ELECTRICAL REVIEW

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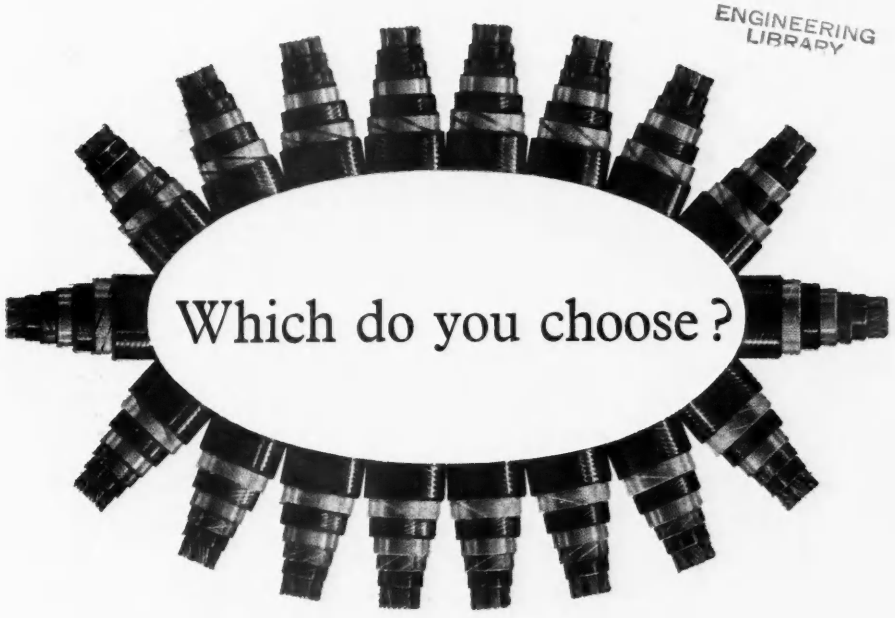

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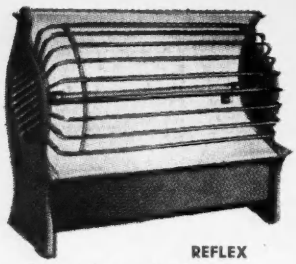

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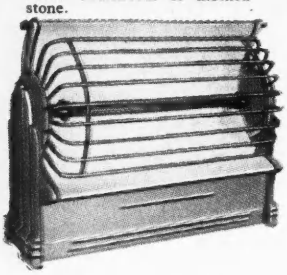

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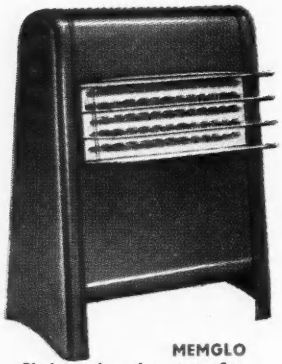

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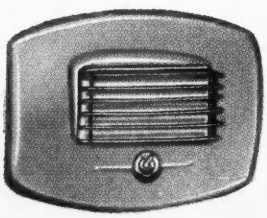

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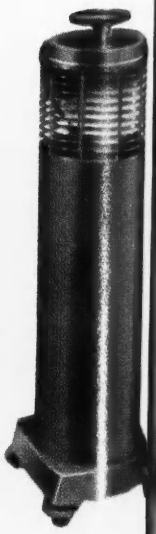

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ELECTRICAL REVIEW

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30 NOVEMBER 1956

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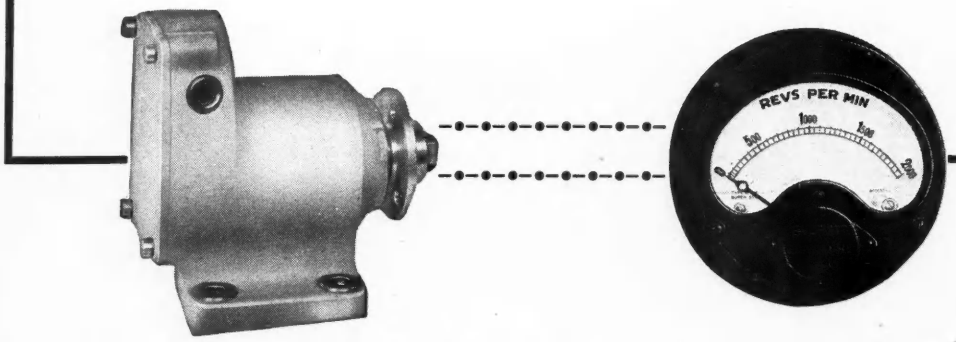
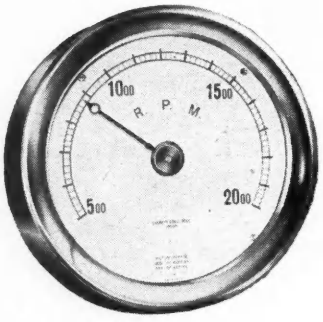
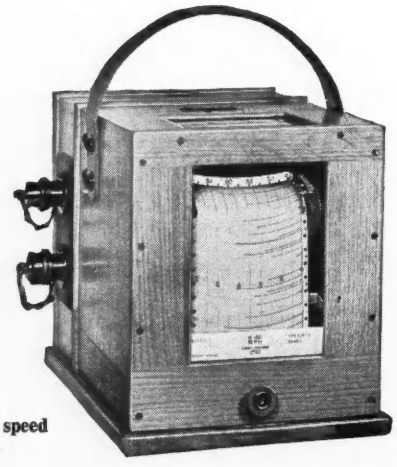
Electric Speedmeters



Typical speed transmitter for floor or bracket mounting.



Disc scale indicating speedmeter.



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ELECTRICAL REVIEW

30 November 1956 Vol. 159 No. 22 Established 1872

Technological Education

NOT the least interesting part of Mr. Eccles' account of his Russian visit, reported in our issue of 16th November, was that devoted to technical education. The same subject was dealt with from a slightly different angle by Dr. Bowden in his paper " The Development of Technological Education in Europe, America and England," which is summarised in this issue (page 996). Both of the speakers were impressed by the tremendous development of technical education in Russia and her almost astronomical output of trained technologists. Dr. Bowden gave figures for the number of comparable first degrees in technology granted in 1954 per million of the population, there being twice as many in the U.S.S.R. as in the U.S.A., and five times as many as in the U.K. One result is that the Russians have, for example, a dozen times as many metallurgists as we have per ton of steel made.

In Russia everything possible is done to maintain the stream of technical students from its source in the schools. Girls as well as boys are encouraged to take science and about one-third of the technical graduates are women : teaching posts are well-paid and well-regarded, and one-third of all graduate scientists become teachers, thus maintaining the succession. This is in marked contrast to the position in this country, and still more in America where the schools are drained of the appropriate staff because a good science master can earn two or three times as much in industry, and where, last year, only about 5 per cent of high school children studied physics.

Comparisons can, however, be very misleading, especially between countries whose situations are so diverse as those of the U.K. and the U.S.S.R. Russia had an enormous leeway to make up, and employed widespread technical education as part of the drive to make industrial workers out of peasants. Our position was the exact opposite. We started the century with an unquestioned lead in the industrial sphere but it was a lead based on our natural resources, our enterprise and our inventions rather than on our studies. It owed very little to formal education and very much to inspiration and a brilliant empiricism. During the last fifty years we have lost much of that lead to countries making a more vigorous use of the latest knowledge and technique. Not infrequently we have been outdone in the exploitation of ideas which we ourselves have originated. Our most urgent need is to match our achievements in pure science and fundamental research with an equal eminence in applied science and technology.

Recently the Government announced its intention of spending £70 million within the next five years on the expansion of technical education throughout Great Britain, and last week it was stated that £34 million would be spent on new university buildings during the next three years. These are considerable sums but they are certainly not large in relation to the need or in comparison with the sums which competing nations are spending. Moreover they follow a period of shameful neglect in the field of technological education. It remains to be seen whether they will be sufficient to restore our competitive position *vis-a-vis* other industrial countries, or whether they will once more prove to be " too little and too late."

RESEARCH REACTOR

The new heavy water moderated reactor, known as "DIDO," which has just been put into service at Harwell, will be of considerable value to designers of nuclear power stations, since it provides a neutron intensity forty times that hitherto available in this country. This will reduce the time required to carry out tests on components for future nuclear power stations from years to weeks, thereby making DIDO of great importance to our nuclear power development programme.

With the aid of this reactor hot carbon dioxide or other gases can be circulated past fuel elements of different kinds to see how much the operating temperatures of gas-cooled reactors of the Calder Hall type can be increased. The behaviour of liquid fuel containing enriched uranium can be studied and investigations can be made into the interaction of hot water with reactor fuel elements. Another use for the reactor is in connection with the displacement of atoms by neutron bombardment, which affects the physical properties of metals; the increase of creep under irradiation is an important example of this type of work.

There are many other important uses for this reactor and all the numerous tubes, holes and beams have been allocated to various users. There is also already a queue for the companion reactor PLUTO which is to come into operation next year. Harwell is to be congratulated upon the successful design and construction of the most powerful experimental plant of its kind in Western Europe. It will, no doubt, make a great difference to the speed of development of the British nuclear power programme.

TOWARDS PRODUCTIVE EFFICIENCY

We recommend our readers to study the review which appears elsewhere in this issue of a joint publication by the British Standards Institution and the Institution of Production. The publication contains the text of two lectures by Professor Harold W. Martin and appears under the broad title of "Variety Reduction by Simplification, Standardisation and Specialisation," which is represented as the "three S's" which are fundamental to the productive efficiency of modern industry and form three closely related concepts.

The main reason for our commendation lies in the definitions of and distinction between various aspects of standardisation which we feel are not properly understood or sufficiently appreciated by many production and allied engineers. It is pointed out in one lecture that variety reduction relates to products that are already made and sold and involves a sieving-out process to eliminate marginal, unpopular and uneconomic products in the interests of increased productivity and lower costs through simplification. Standardisation, on the other hand, is the establishment of desirable product criteria with respect to operating characteristics, size, shape, quality and the like. In the second lecture the author defines and analyses the term "standards engineer" and the relation of the standardisation function to the control of human endeavour.

IMMERSION HEATERS

Continuing our series of illustrated surveys of domestic electrical appliances, next week (7th December) we shall be dealing with immersion heaters. Included in the particulars to be given in tabular form will be details of the type, length, loading, size of head, price, purchase tax, etc.

MOBILE POWER STATIONS

Elsewhere in this issue we refer to the mobile power stations which have been adopted by the South Western Electricity Board as a means of providing temporary supplies wherever possible while essential work is being carried out on the rural network, thus helping to minimise interruptions of supply for maintenance or repair work.

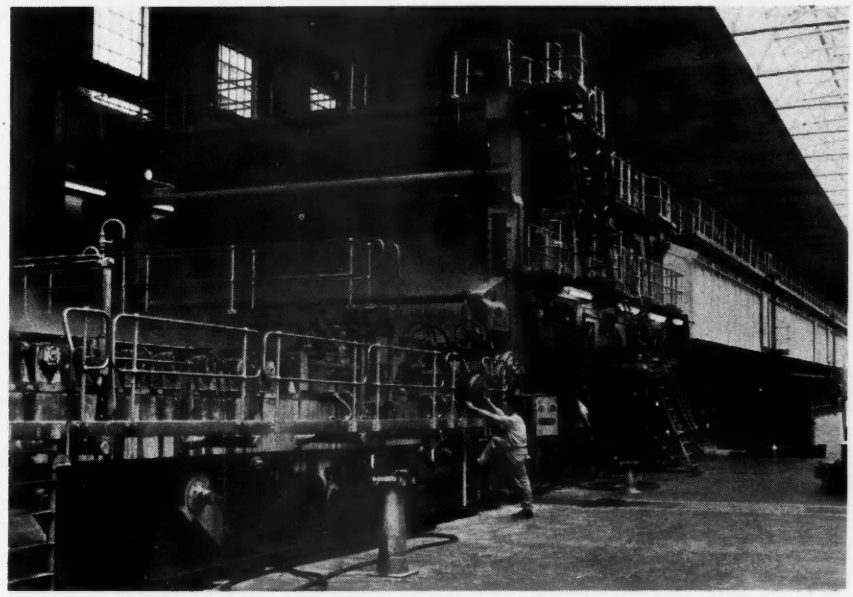
This reminds us of the "aid to Russia" period during the last war when many of our leading electrical manufacturers were busy producing portable and transportable power stations which were intended largely for the purpose of getting electricity supplies going again in the war-devastated areas. The transportable power stations were considerably larger than the mobile power stations of the South Western Electricity Board, and they were arranged to be sited on a semi-permanent basis. Some of them carried a boiler, a turbo-alternator set, switchgear and transformers, all of fairly considerable capacity.

It is with this picture of the semi-permanent power station in mind that we wonder whether it would not be possible to extend the use of the S.W. Board's mobile plant to giving semi-permanent supplies by "transportable" power stations to areas which require a considerable period of development before a normal supply, say, by e.h.v. transmission line, substation and network, could be justified economically.

VARIABLE SPEED MOTORS

For many years there has been a real need in industry for a variable speed a.c. motor which would be cheap, simple, easily maintained and reliable. It is not an easy matter to design a variable speed a.c. drive since either the machine itself becomes complicated with brushgear, commutators and special windings, or some external equipment is required which may cost more than the machine itself. However, a step in the right direction has recently been made and a variable speed induction motor requiring no complicated external control gear has been designed.

This machine is fully described in the I.E.E. paper by Professor F. C. Williams and Messrs. E. R. Laithwaite and L. S. Piggot which was summarised in our last issue. The machine has a good speed range and is of robust construction. It is more expensive than a normal squirrel cage induction motor but cheaper than other a.c. variable speed machines. The efficiency and weight/power ratio are also of reasonable proportions. It is a long time since a new type of electrical machine was designed and we can only hope that further development of the brushless variable speed induction motor will provide industry with something it has been wanting for many years.



Large-Scale Paper Making

New Machine and Power Plant at Kemsley Mill

ALREADY claimed to be Europe's largest groundwood pulp and paper mill, the Kemsley Mill, near Sittingbourne, Kent, of the Bowater Paper Corporation, Ltd., has been extended by the addition of No. 6 machine. This has involved an expenditure of about £2½ million and will add 60,000 tons of newsprint a year to the mill's output. It is designed to make, supercalender, and reel a sheet 22½ft wide at up to 2,300 ft/min. The finished reels weigh about 12 tons each and consist of over 12 miles of paper.

To meet the requirements of the extended mill the Corporation has installed new Babcock & Wilcox cranes at its Ridham Dock, to which the raw materials are brought by ship, new roads, railways and rolling stock, a pulp-stacking yard, three pulping machines with mechanical handling equipment, new paper stores and maintenance shops and a complete new power plant.

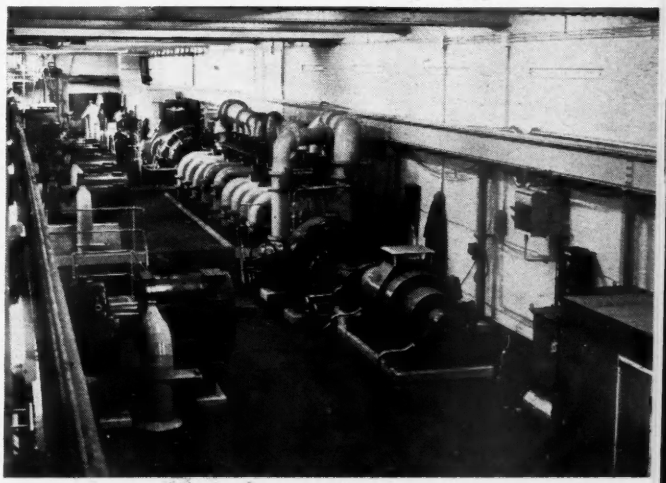
The paper machine is designed to operate at between 900 and 2,300 ft/min and it is equipped with a B.T.H. multi-motor-generator drive. Two 1,400 h.p. 6·6 kV synchronous motors drive two d.c. multi-generator sets which supply the section motors. Generator voltage, and therefore motor speed, is closely controlled by individual tachometers and electronic equipment. The electronic regulators are of the withdrawable tray pattern for ease of maintenance. The operator's controls for each section consist of an " Off-Crawl-Run " switch, a draw rheostat, and a slack take-up button. Electronic control dispenses with belts, cone pulleys, etc., and has a very fast inherent non-oscillatory response, minimising the transient effect of load changes. The machine speed can be varied over the whole range and each section can be individually adjusted to compensate for paper stretch (" draw ").

The various sections of the machine are driven through B.T.H. gear boxes and Wellman Bibby couplings and the motor ratings are as follows:—Crush and forward drive rolls 550 h.p.; first return wire roll 20 h.p.; pick-up roll 50 h.p.; wringer suction press 150 h.p.; three suction presses 275 h.p. each; first suction press, top roll 50 h.p.; three dryer sections 550 h.p. each; calender 550 h.p.; Beloit reel 150 h.p.

A 750 h.p. motor drives the supercalender which is also

Title picture : Wet end of new paper-making machine showing wire section and suction pick-up installation

Main drives for wet end (left) and turbo-blowers



Main drives for dry end of machine

equipped with a 60 h.p. braking generator for the unwinding reel and a 90 h.p. motor for the wind-up reel which both have purely electrical automatic constant tension control. To indicate the onerous conditions in which the equipment operates it should be mentioned that the supercalender has an operating speed of 3,300 ft/min and the reels weigh up to 17 tons. In the control system amplidynes are employed and these enable the operator, despite the high reel inertia, to run the machine at any speed and accelerate or decelerate it with reels of any diameter between 22 and 88in without touching the tension control.

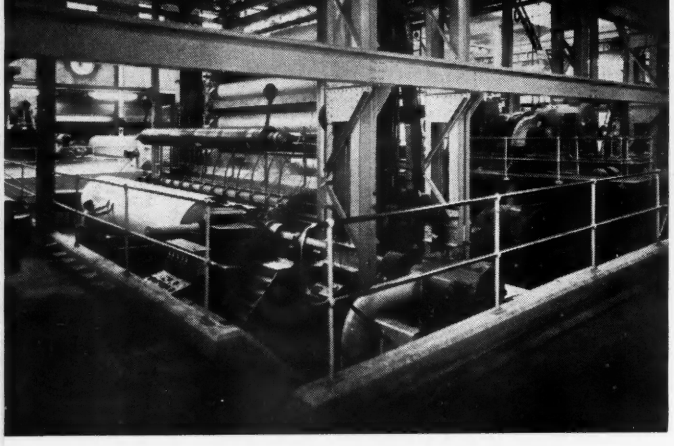
Similar tension problems have been dealt with in the case of the winder drive which runs at 5,000 ft/min and has a 160 h.p. main motor and a 100 h.p. braking generator. A stable creep speed is ensured by amplidyne control and for emergency stopping regenerative braking under constant-current control is used. Powerful friction brakes as well as dynamic braking are provided for stopping the unwinding reel.

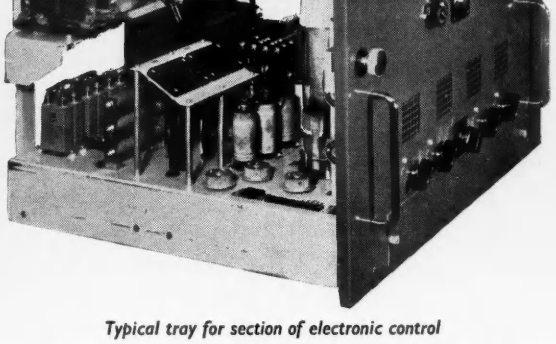
Bowaters already had about 70 MW of power plant at Kemsley and a 6 MW set at the neighbouring Sittingbourne Mill. The new machine called for about 6 MW and the groundwood plant extensions for 9 MW and so it was decided to install a new 15 MW set and at the same time reconstruct the process steam arrangements. It was considered that the best thermo-dynamic solution would be the marrying of the steam requirements of the two mills, employing a pressure of 1,550 lb/sq in and a temperature of 925 deg F. Consequently, it was decided that the new back-pressure turbine should operate in these conditions and exhaust into the existing 350 lb/sq in 700 deg system. The mills are being linked by $2\frac{1}{2}$ miles of continuous medium-pressure steam and condensate pipe lines run on the surface.

To provide the steam for the new set it was necessary to install a 450,000 lb/hr boiler and to arrange for the exhaust steam from the turbine to return to the boiler for re-heat to the temperature of the existing medium-pressure system. At the time of its erection this Stirling boiler was said to be the largest industrial unit in Europe. The new boiler plant will provide almost all of the steam requirements of the two mills, superseding seventeen old boilers and resulting in a saving (as compared with extending the existing plant by 15 MW of pass-out/condensing power on the old system) of at least 50,000 tons of coal a year.

The boiler has a heating surface of 10,340 sq ft, the superheater 8,150 sq ft, the economiser 19,150 sq ft and the air heater 33,300 sq ft. The main steam drum (5ft 6in internal diameter, $4\frac{13}{16}$in thick) weighs 56 tons and is suspended by laminated slings from overhead steelwork. Bailey Meters control is provided and the feed-water control is on Copes "Flowmatic" system. Pulverised fuel firing is employed, there being sixteen 10in opposed vertical intertube burners. Coal is pulverised in four Stirling "E56" mills.

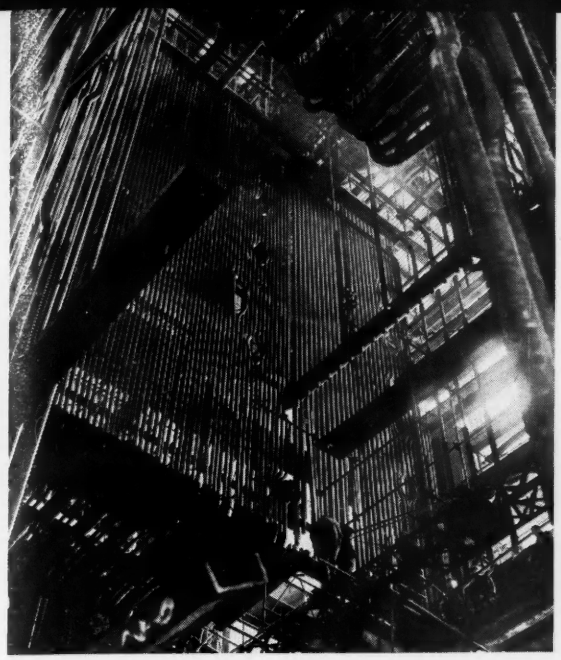
The English Electric turbine is a single-cylinder twelve-stage back-pressure machine designed for an inlet steam pressure of 1,500 lb/sq in and temperature of 900 deg F; the back pressure is 370 lb/sq in. The alternator runs at 3,000 r.p.m. to give 15 MW at 6·6 kV at a power factor of 0·8 lagging. A supervisory panel near the steam end of the set has instruments recording speed, shaft eccentricity and shaft expansion relative to the turbine casing. An Askania controller is fitted to the main governor to maintain back pressure constant to within ± 5 lb.

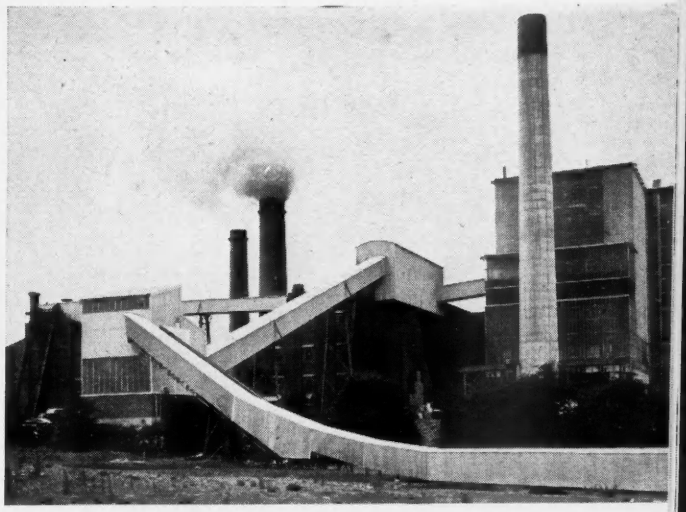




Typical tray for section of electronic control

Left: Supercalender (3,300 ft/min) driven by a B.T.H. 750 h.p. d.c. motor





Left: View of tubing taken during the erection of the new boiler. Right: Eastern aspect of power station. The conveyor takes in railborne or seaborne coal, direct or from storage

Two main pressure reducing desuperheating stations have been installed in parallel with the turbine to enable steam to be passed from the new boiler direct to the existing low-pressure system, by-passing the turbine, or to work in parallel with the turbine at low loads. These take steam at 1,550 lb/sq in and 925 deg F; the control pressure is 350 lb/sq in and the desuperheater outlet temperature 600 deg F. Each unit has a capacity of 225,000 lb/hr.

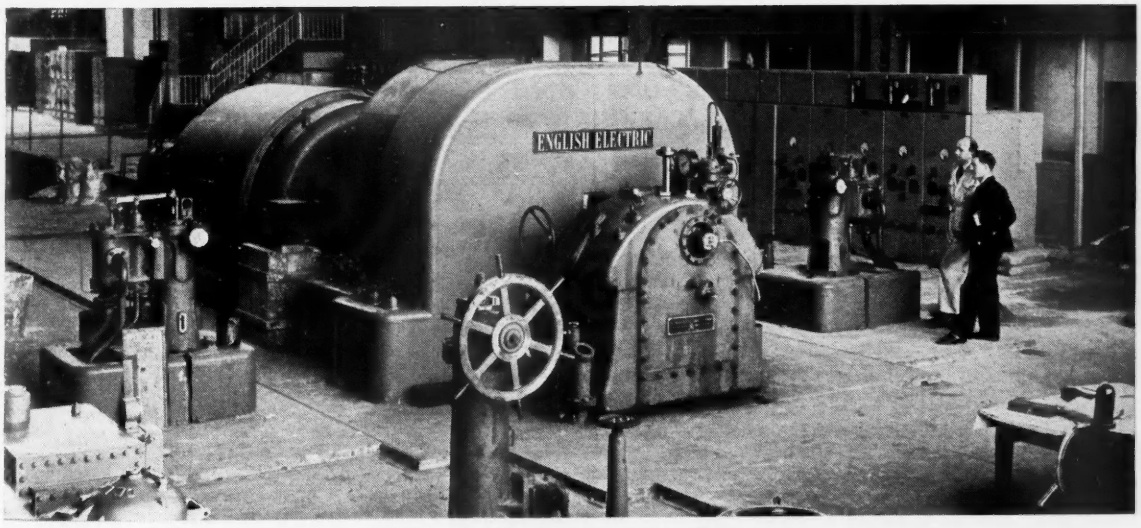
The feed water for the boiler consists entirely of condensate from turbines and paper machines, make-up being supplied to the old l.p. boilers from a new 300,000 lb/hr water softening plant.

The Babcock & Wilcox coal-handling equipment from the jetty to the boiler house store and boiler houses is ¾ mile long and consists of a system of seven conveyors.

Ferguson Pailin, Ltd., supplied the equipment for the 6·6 kV 500 MVA main switchgear extension and the English Electric Co. the 3·3 kV 150 MVA switchgear. Other switch and control gear was provided by the B.T.H. Co., Contactor Switchgear, Ltd., Switchgear & Cowans, Ltd., and the Electro Mechanical Manufacturing Co. Johnson & Phillips, Ltd., supplied two 6·6/3·3 kV 6,000 kVA and two 3,300/430 V 1,250 kVA transformers. Enfield Cables, Ltd., and W. T. Henley's Telegraph Works Co. were responsible for 6·6 kV feeders between the two mills.

Accommodation has been reserved in the turbine hall for the 10 MW G.E.C. turbo-generator from the central power house and for the 6 MW G.E.C. set from the Sittingbourne Mill. To augment the power generated at Kemsley arrangements are being made to take a supply of up to 20 MW from the South Eastern Electricity Board. The whole of the expansion and development at the Kemsley Mill has cost almost £5 million of which the new paper-making machine took about half.

Messrs. Ewbank & Partners are the Bowater Paper Corporation's engineering consultants for this work; the architects are Messrs. Farmer & Dark; and the building contractors Messrs. Higgs & Hill. The general cable



The new 15 MW English Electric turbo-alternator

Main power station control room

contractors were Tanjon (Newcastle), Ltd., and the power station cabling and lighting were carried out by Barlow & Young, Ltd.

The chief electrical engineer of the Bowater Paper Corporation is Mr. A. C. G. Witts, B.Sc.(Eng.), A.M.I.E.E., and the electrical engineer at Kemsley is Mr. E. J. Hatch, A.M.I.E.E.

Other suppliers of equipment in addition to those already mentioned were as follows:—Motor control panels: Allen West & Co., Belmos, Ltd., Dewhurst & Partner, Ltd., and G.W.B. Furnaces, Ltd. Lighting: Grierson, Ltd., and Edison Swan. Machine drive ventilating ducting, Ozonair, Ltd. Boiler and turbine house equipment: Dewrance & Co., Ltd., Hopkinsons, Ltd., George Kent, Ltd., Hamworthy Engineering Co., Duncan Low, Ltd., Radiovisor Parent, Ltd., Elliott Bros. (London), Ltd., Drayton Regulator & Instrument Co., Ltd., Evershed & Vignoles, Ltd., G. & J. Weir, Ltd., Aiton & Co., Ltd., Gwynnes Pumps, Ltd., Drysdale & Co., Ltd., Worthington Simpson, Ltd., Broadwell Engineering Co., Ltd., Keith Blackman, Ltd., James Howden & Co., Ltd., Mather & Platt, Ltd., and Newton Chambers & Co., Ltd. Transformers: Gresham Transformer Co., Ltd.

Policy on Trolley-Buses

A REQUEST that the Government should postpone the plan to replace London's trolley-buses by diesel oil buses at a capital cost of £10 million, with ancillary expenditure of perhaps double that amount, was made by Mr. Arthur Palmer when he initiated an adjournment debate on this subject.

He said he had always thought this plan regrettable but the cut in oil supplies caused by the events in the Middle East made it even more so. There were many objections. Diesel vehicles were an offence to the senses, particularly in the narrow London streets. They were noisy and there was at least a suspicion that the diesel fumes were a contributory cause of lung cancer. It could also be argued that at a time when there were restrictions on capital expenditure this large sum which was to be spent on replacing perfectly sound electric vehicles could be put to better use.

It was short-sighted folly to make the entire surface transport of the largest city in the world dependent on fuel, almost every drop of which had to be brought in from overseas. The Suez crisis should at least have caused the London Transport Executive to stay its hand. Ever since July there had been this risk of oil restrictions, yet it was since then that the Executive had placed contracts for the first of the new vehicles. In a sense, he could forgive them; they might take a narrow view; they might gaze on smaller horizons and not on the wider world. But it was very difficult to exempt the Minister of Transport from blame because as recently as 31st October he was saying, "The additional consumption of diesel oil will be comparatively insignificant." If there were hundreds of diesel buses running week in, week out, year in, year out, how could it be comparatively insignificant? Who was to know that the present crisis was only temporary? Oil came from a part of the world where there was constant political disturbance. "It was a curious fact that while this country, dependent on imported oil, had a tendency to do away with the electric road vehicle, in Continental cities and even in the U.S.A.—with all their oil resources—they were extending the use of such vehicles."

Whatever the Minister might have overlooked in the past, he now had every reason in the national interest at least to postpone the implementation of this mistaken policy. . . . Let the interval be used by the Executive to discuss with the British electrical industry, which had great experience and knowledge of these matters, how modern electric road surface traction could be adapted to meet London's traffic needs in great part. A vast amount could be done by a proper co-operation between the engineers and experts of the Executive and the electrical manufacturing industry. If that were done for London, other great cities would follow a sound example.

Preparing for Atomic Power

Declaring that it was disastrous from the economic, strategic and financial standpoints to swing our reliance from indigenous coal to imported fuel oil, Mr. Gerald Nabarro said we were building large and expensive atomic power stations which must be used to maximum efficiency if the nation's investment was to yield the optimum results. We should try to switch as many diesel buses to electricity, instead of the reverse process, to pave the way for the utilisation of atomic power. The private motorist would be hard hit by rationing. He would not take kindly to public corporations consuming vast amounts of diesel oil and petrol while doing away with the highly-efficient electric vehicles now in use.

Replying, Mr. Hugh Molson, Parliamentary Secretary, Ministry of Transport, said there was absolutely no evidence that oil engines were responsible for the rise in the incidence of lung cancer. It was suggested that at a time of restricted capital expenditure it was unjustifiable for the Executive to invest £10½ million in new Routemaster buses, but the Chancellor of the Exchequer said on 17th February that the Transport Commission had made all the reductions in capital expenditure that had been asked of it this year.

The main argument was that in the present difficulties the Minister should reverse the policy which had obtained the support of the Chambers Committee who investigated the general administration of London Transport. This committee had said that the change was justifiable on commercial grounds. The order for the first of the 1,500 buses had been given but they would not come into service until 1959. The Government hoped that long before then oil supplies would again be normal.

He gave these reasons why the Minister continued to support the Executive's policy: a diesel bus was cheaper to buy than a trolley-bus of equivalent capacity; it was more mobile in traffic and more flexible in operation; in that way it reduced street congestion and enabled the standard of service to be improved; unlike the trolley-bus it was not subject to mass hold-ups through dewirement and when there was a local power failure there were not a large number of immobilised vehicles in the streets; and it had been proved by experience to afford material economies and better service. Having all the vehicles of the same kind would result in a reduction in maintenance and repair costs. These were reasonably conclusive arguments why the Minister declined to withdraw his support from the Executive.

Reduction in Variety

Standardisation and Simplification Aid Productive Efficiency

THE three S's—simplification, standardisation and specialisation — are fundamental to the productive efficiency of modern industry and form three closely related concepts. They are the " text " forming the basis of two lectures given in London in May last by Professor H. W. Martin, Professor of Management Engineering of the Reusselaer Polytechnic Institute, New York. Prof. Martin is at present acting as consultant to the European Productivity Agency in connection with a programme of lectures, conferences and training courses in simplification, standardisation and variety reduction, which are being held in various European countries.

Willingness to Buy

The two lectures given by Professor Martin in London have now been published jointly by the British Standards Institution and the Institution of Production Engineers. The first, given at the Production Conference at Olympia, is entitled " Investing in Simplification and Standardisation." The customer's willingness to buy, says Professor Martin, is the key to sales productivity, this being affected by such factors as usefulness, quality, attractiveness of appearance and, of course, price. Accurate information regarding the relative willingness of the average customer to buy each of the products offered for sale is of vital importance, and various methods of obtaining this information are discussed. One such method is to analyse sales records already available, and such an analysis might reveal that the popularity of some products is due to their being sold at unprofitably low prices. Analysis of sales by profit per product is therefore essential, and the process by which such an analysis may be made are described, typical charts being given. These data provide indispensable guides to intelligent product assortment planning, or reduction in the variety of products manufactured and offered for sale. Sale prices, originally based on former selling and stock costs, can then be re-appraised in the light of the reductions in costs generated by the simplification programme.

Standardisation and Sales

This, in turn, will accelerate the desired simplification of the selling process. There is a widespread tendency for sales personnel to advocate the making, stocking and selling of items not previously sold, under the mistaken impression that each additional item available for sale will simplify the attainment of sales income objectives. But the fact is that diplomatic refusal to satisfy marginal customers' demands tends to generate a competitive advantage by reducing selling and stock costs, thereby enabling selling prices to be reduced.

The distinction between variety reduction and standardisation is not always understood. Variety reduction relates to products that are already made and sold, and involves a sieving-out process to eliminate the marginal, unpopular and uneconomic products in the interest of increased productivity and lower costs through simplification. Standardisation, on the other hand, is the establishment of desirable product criteria with respect to operating characteristics, size, shape, quality and the like. This often entails time-consuming research, and much needed reduction in the variety of products offered for sale may be delayed because of the emphasis on standardisation rather than simplification.

Professor Martin then deals with the problems of simplification in designing and in manufacturing, and the conclusion is drawn that their combined effect makes possible significant increases in earnings for workers, executives, owners or stockholders alike while at the same time radically reducing capital needs and enabling products to be offered to consumers at lower prices. The rewards from simplification and standardisation demand a management with the vision, the social responsibility and the courage to recognise that these rewards have to be earned, to be planned for and organised on a permanent and continuing basis. Because their full achievement demands co-ordinated action by all divisions of industry, the ultimate responsibility for their attainment must necessarily be accepted by top management.

Economic Production

The second lecture, entitled " Standards, the Standards Engineer and Economic Production," was given at a Conference of Standards Engineers held at the British Standards Institution in co-operation with the Institution of Production Engineers. Professor Martin examines the fundamental nature of the standardisation function and its relation to the control of human endeavour. The specific responsibilities of the standards engineer are broadly defined as the development and installation of economic and accurate standards of performance for all possible functions to be performed in achieving the objectives of an industrial enterprise. These responsibilities are wider than those usually given to standards engineers in this country, and the paper may be expected to enhance the authority of standards engineers.

In a specific example dealt with the cost reduction programme, in profit-volume chart form, for a medium-sized (500 employees) firm, is discussed. The firm manufactures a range of 42 different sizes of products of the same general type in relatively small quantities. In 1951 the concern experienced a loss, and a standards engineer was given the task of determining how to convert the 1951 loss into a 1952 profit. After due analysis he recommended a programme of cost reduction and control based on an intensive schedule of standards development and improvement. To implement the programme the standards engineer was given supervisory authority over, and responsibility for, work study engineering, tool design, long-range forecasting and scheduling, plant layout and cost standardisation and control. Thus he was responsible for substantially all aspects of planning and standardisation except product design, over which he had, however, a watching brief from a production cost point of view.

This example is given to emphasise the need for management to recognise that the standards engineer, given due status and managerial support, can do much to improve the economy of production.

RADIO SHOW, 1957

The Radio Industry Council announces that the 24th National Radio Show will be held at Earls Court, London, from 28th August to 7th September, 1957. There will be a preview on 27th August.

Technological Education in Europe

Development Surveyed in Institution of Production Engineers' Paper

THE 1956 Sir Alfred Herbert paper was presented to the Institution of Production Engineers in Manchester on 19th November by Dr. B. V. Bowden, Principal of the Manchester College of Science and Technology, whose subject was "The Development of Technological Education in Europe, America and England."

In a fascinating historical introduction Dr. Bowden showed how little our industrial revolution has owed to academic education. Most of the brain power behind this vast upheaval which has reshaped the whole of the modern world and which constituted our greatest national contribution to the wealth and welfare of mankind, came almost entirely from self-taught men, from dissenters who were kept out of the universities by statute, and from students who had been to private academies.* For nearly 100 years the most important technological developments in this country were made quite independently of the universities and sometimes in the teeth of hostility from both university and church.

The neglect of science, and still more of technology, by the older universities was partly made good by the learned societies. The most famous of these was the Royal Society of London, although the provinces also had their associations. The Lunar Society of Birmingham was frequented by Boulton and Watt, Wedgwood and Erasmus Darwin, who defined a fool as "a man who has never done an experiment in his life." The Manchester Literary and Philosophical Society, founded in 1781, did much to promote both science and technology and to bring them and their exponents together. Joule was a member, and so also was Robert Owen (the father of English Socialism) as well as Playfair and Calvert, both of whom became famous as chemists before they made their fortunes in industry.

The English public schools, like the universities, were slow to shake off the traditions of the Middle Ages; apparently some of them have failed even yet to realise that it can be more important for a schoolboy to understand something about the tools of modern industry than it is for him to learn about Jupiter's love life, or to study the properties of Greek and Latin verbs which, to the delight of the pedagogue, are irregular to the point of impropriety in their behaviour.

No Monopoly of Skill

Unfortunately, the start which this country had in the industrial revolution could not last for ever. When the Great Exhibition of 1851 showed us what foreign countries could do, many of our industrialists realised for the first time that we no longer had a virtual monopoly of manufacturing skill, and that "no further triumphs awaited mere vigour undirected by knowledge." Suggestions were made for the setting up of an "industrial university," and the profits of the Great Exhibition were used to buy those estates in Kensington where the Imperial College now stands. In the meantime other countries had felt the same need and had set about to satisfy it far more quickly than we. The Technische Hochschule in Zurich was founded in 1855 and to-day has about as many undergraduates as the Imperial College, London, Manchester College of Science and Technology and the Royal Technical College, Glasgow, put together—although the whole population of Switzerland is only five million. Six years later than the Zurich college came the Massachusetts Institute of Technology. By the end of the 19th century there were five times as many university students in Germany as in this country, the government was subsidising research in the Hochschulen, the universities and in industry, and the Germans led the world both in industrial chemistry and in the manufacture of precision optical instruments despite the fact that aniline dyes were discovered in England in the 1850s, and John Dolland had made achromatic telescopes for the Duke of Wellington.

Relative to other countries our backwardness has always been, and still is, in the field of technology rather than pure science. Dr. Bowden gives the following figures relating to the number of first degrees awarded in 1954 per million of population in seven different countries. Three are as follows:—*Pure Science*: U.S.A., 144; United Kingdom, 105; U.S.S.R. (coming 4th) 56. *Technology*: U.S.S.R., 280; U.S.A., 137; United Kingdom (coming 6th) 57.

Are Government Plans Adequate?

At last, however, we have been jerked into something like a realisation of the seriousness of our position. After much examination of the pros and cons the Government has decided against a completely new Institute of Technology. Instead, three existing Colleges of Technology are to be enlarged and a sum of £70 million is to be spent within the next five years on the expansion of technical education throughout Great Britain. This sounds a large sum though it only represents about 30s a head of the population, and it is certainly not large in comparison with the sums spent elsewhere. The question is—will it be adequate to make up for the neglect of half a century and to put us in a position to compete with confidence with other industrial countries?

Moreover, the university rests upon the school, and no expansion of technological education can succeed unless there is a sufficient flow and quality of entrants. Recent experience in the U.S.A. should be a warning to us here. Despite all that the Americans have been able to do they estimate that their industry desperately needed 40,000 fully trained engineers last year, but only 22,500 graduated. This unexpected and catastrophic decline seems to have occurred, despite the magnificence of the American universities, because of the shortcomings of American schools. Science masters are grossly underpaid and can easily double or treble their salaries by working in industry. Small wonder that in spite of the glamour and publicity with which science and technology are surrounded only four-and-a-half per cent of American high school students studied physics last year.

Here, as there, the whole problem is deeply rooted in our educational system and traditions, and the science shortage operates through a vicious circle of teacher, scholar, graduate and career. Three-quarters of the

*Because the universities refused to admit students who were not members of the Church of England the Dissenters (particularly the Quakers) established their own academies, with the curious result that a man had about 30 times more chance of being elected to the Royal Society if he were a Quaker or of Quaker descent than if he belonged to the general population.

and America

ablest young schoolmasters in this country are non-scientists. They must inevitably persuade hundreds of their pupils to follow in their footsteps, although many of them might do well in science if they had a chance. In girls' schools the position is usually much worse. Each girls' grammar school in England is now able (on the average) to recruit one good honours graduate physics mistress once every 100 years: it is hardly surprising that we have never had many women technologists in this country. It appears that good science masters are a dying race in England; the species is almost extinct in America, though it flourishes in Germany where grammar school masters command adequate salaries; moreover, their profession is still admired and respected by the public. A survey has recently shown that about 50 times as much effort in all training colleges in the country goes to arts and crafts as is devoted to physics or chemistry; and this at a time when our whole national economy entirely depends upon applied science and technology.

Russian Technical Advance

By contrast, the Russians, having to make industrial workers out of an illiterate peasantry in a hurry, based their whole industrial expansion upon an enormous programme of technological education. For example, the Baumann Institute in Moscow, founded as a trade school in 1830, is now a "Monotechnic," specialising in the education of mechanical engineers, with a staff of 750 and 10,000 students. The study courses involve about 5,000 hours of instruction spread over five-and-a-half years. (Most English undergraduates have about 2,500 to 3,000 hours of instruction in three years.) There are 30 other engineering schools in Moscow which accommodate altogether nearly 150,000 students, about one-third of whom are women. In addition, there is Moscow University which has been reconstructed at enormous expense on a 300-acre site in the very heart of the city, and there have been parallel developments in Leningrad and Tiflis.

Russian students have a maintenance grant that is independent of the income of the parents. No student of science and engineering has to do military service. One-third of all graduate scientists become teachers, and the profession is sufficiently well paid to make it attractive to them. The whole of Russia's educational system is based on science and technology as firmly as the English system was based on the classics 70 years ago. It was once almost inevitable that a clever boy in a good English school would study classics; clever boys in Russia to-day almost as inevitably do science. The Russians are certainly now producing far more technologists than the whole of the Western World put together. Very soon they may be in a better position than the West to give technical assistance to the undeveloped countries.

In view of the poor showing made by the British figures it may seem surprising that our industries succeed as well as they do: that we can sell aeroplanes to America and that we still hold all the world's speed records on land, sea and air. Part of the answer is that figures for totals often mask great differences in the parts. Any observer of the industrial scene of Manchester must be struck by the enormous variation between the scientific and technological standards that have been achieved by different local industries. Chemistry and electrical engineering, for example, have always been based on a rapidly developing scientific background, whereas textiles, paper making, printing and building, which are just as important, have developed from traditions hundreds of years old, and the skill and traditions of their craftsmen are still all-important.

Our greatest achievements have been in the realm of pure science and the discovery of fundamental new knowledge, and our greatest need is to match this by progress in technology. Our position here is the reverse of that in America where for years Congress turned a deaf ear to all proposals for creating scientific institutions which were not content with limited utilitarian objectives. It is doubtless true, as Sir J. J. Thomson once remarked, that "If applied science makes improvements, pure science makes revolutions." But the two sides must advance together, and the cost of developing a scientific discovery into something which can be manufactured on a commercial scale is always many times greater—often hundreds of times greater—than the cost of the initial discovery upon which the work ultimately depends.

Dr. Bowden's final conclusion carries a very special message for electrical engineers. "It is essential that our industry should attract its fair share of the best brains of the next generation; its recruits must be adequately educated if they are to be fitted for their life's work. They will have to learn science or technology—or Russian."

House of Lords Debate

BRITISH and Russian achievements in electrical production and nuclear engineering were compared in the House of Lords when Lord Simon of Wythenshawe called attention to the much greater output of graduate engineers and scientists in Russia and the U.S.A. than in Britain, and the effect which this would inevitably have upon our export trade and standard of living.

He said the desperate urgency of the need for more engineers was illustrated by the experience of his engineering firm which spent £20,000 a year on advertising for scientists and engineers and—broadly speaking—did not get the men it needed. At Cambridge, of the Final Honours Physics School, eight men free of national service were last year faced with a total of 1,034 vacancies.

In the electrical world the Russians were technically ahead in certain developments. They had larger turbines at work; they had higher pressure boilers and higher voltage transmissions—all steps which we should be following in the course of the next few years. Our scientists were recently shown an immense nuclear machine with a magnet weighing 36,000 tons. A professor in Britain who was in charge of the largest cyclotron here had said: "It is quite evident that we in Britain are completely outclassed in this type of large-scale equipment, and that we shall soon be outclassed in experimental results . . . ."

Russia had achieved these results because of the tremendous concentration on the education of physicists and engineers. We had 7,000 graduates or the equivalent each year; Russia turned out 80,000 or more each year, and the engineering courses there lasted five-and-a-half years, the students working 10 months each year. In Britain the engineering course of about three years was the shortest in the world and extended over only about half the months of the Russian course.

The only way to meet the challenge was to produce

more graduate engineers and give them more responsibility. In the nationalised industries the engineers were somewhere well down, except in the Atomic Energy Authority, where top-level scientists and engineers were given high salaries and almost unlimited resources. Their jobs carried great prestige. There was a saying, current in Whitehall circles, that " scientists and engineers should be on tap, not on top." That had been the custom in this country. But in the A.E.A. they had been on top for the first time, with outstandingly good results. The Government's programme for the technical colleges was bold but they should do more to expand the universities; they should spend at least £100 million on them in the next 10 years. The nation, led by the Government, should determine to change the educational system to get the engineers and scientists required, and should do the job with the same resolution as was shown at Calder Hall.

British Electrical Expansion

The Marquess of Salisbury, Lord President of the Council, said Britons need not take too gloomy a view of the future. Russia's production, even where she had made the greatest progress, was well below ours per head of the population and there were indications of a slowing down in the Russian rate of expansion. We should not fall into the common British error of praising only what was done elsewhere and minimising our own remarkable achievements. The expansion of the electricity industry in Britain since the war had also been very spectacular, with an increase of more than 91 per cent in the amount of electricity generated between 1946 and 1955. What was more, an increase in technical efficiency had gone hand in hand with this great expansion.

It emerged from the report on scientific man-power that there were 56,000 scientists and 78,000 engineers employed in Britain—about 0·6 per cent of the population. In Russia it was 0·85 and in the U.S.A. 1·2 per cent. But the striking feature in Britain was that these men were concentrated in relatively few industries. Nearly two-thirds of the 48,800 qualified scientists in manufacturing industry were in groups which accounted for only three-tenths of the total employees in industry.

Lord Salisbury concluded with an account of the programmes which had already been announced, and the new programme for university expansion, which he said would ensure that the output of qualified scientists and engineers would be increased from 10,000 a year to 20,000 a year by 1970, as recommended by the Committee on Scientific Man-power. He said that the National Council for Technological Awards had already established the first of the new awards—the Diploma in Technology—and the first batch of applications for courses leading to this award were already being considered.

Lord Chorley pointed out that the Russians made great use of women scientists while here women were discouraged. Lord Godber regretted that the method of teaching mathematics in the primary schools was such that it left the children with a negative attitude to this vital and fundamental subject, and at worst with a distaste and a fear of it. Viscount Cherwell said the best way to make progress was to set up technological universities. The so-called " massive expansion " at the Imperial College was only a small part of what was required.

Viscount Falmouth considered it unfair that Government departments should draw away graduates who would otherwise go into industry, by promising indefinite deferment from military service. There should either be deferment by special categories or no deferment at all.

Lord Bennett of Edgbaston denied that industry was " twiddling its thumbs " and doing nothing while it waited for the Government. On the contrary, it was doing much by helping the universities, providing post-graduate courses for engineering production, giving special buildings for part-time instruction, giving scholarships and bursaries, helping students with their living expenses and providing much equipment that was needed for teaching. The F.B.I. was also trying to help to secure increased numbers of science teachers.

Viscount Caldecote wondered whether the time had not come to introduce differential grants to ensure that more entrants to the universities studied science and technology. It was rather sad to notice that the plan for expansion of the technical colleges which was now being put in hand was almost the same as that proposed by the professional institutions in 1949, but then disregarded.

The Earl of Halsbury said Lord Simon had mentioned a Russian magnet which weighed 36,000 tons. For people who tended to worship large inanimate objects no doubt this was a most worshipful thing. But he had been told that there was at least 18,000 tons too much steel in that magnet and that it could have been built smaller. In considering particle accelerators we must remember that we were in a leapfrog race that was going on the whole time. At the moment Berkeley was ahead with a 6,000 MeV accelerator, but the great C.E.R.N.E. project in Geneva would jump past that with 25,000 MeV. For policy reasons we did not build one of these accelerators in Britain; we preferred to join the co-operative effort in Geneva. We should not forget, too, that the designer of that great project was a British electrical engineer.

There must be a sense of urgency in Britain. The big I.C.I. building on the Embankment took only 18 months to build, yet what had happened at Imperial College after two years? The nation had got into the habit of being satisfied with a tortoise-like rate of progress. Our competitors did not make that mistake.

More Science Students

Replying to the debate, the Earl of Home, Secretary of State, Commonwealth Relations, said that a case had been made for a revolutionary change in education as a prior condition for a comparable revolution in industrial practice. In the boys' grammar schools now 60 per cent of the sixth formers were specialising in mathematics and science and in the public schools it was about 50 per cent. The complaint that science was not getting its fair share of the best brains was not borne out by the facts, because 51 per cent of the State scholars last year went to the universities to read mathematics or science.

While the Lords debate was going on, Mr. Henry Brooke, Financial Secretary to the Treasury, made a statement in the Commons on the Government's plans to meet the greatly increased demand for university education and the national need for more university-trained scientists and technologists. The universities had already made proposals to the University Grants Committee which, taken together, would increase the number of students from 84,000 in the academic year 1955-56 to 106,000 by the mid-1960's. Of this increase, it was expected that about two-thirds would study science or technology. The Government had given authority for university building projects up to the value of £10·4 million to be started in 1957, £12 million in 1958 and a further £13 million in 1959, over and above the large sums required for the expansion of Imperial College. Large though this increase was, the Government believed that the universities should be encouraged to expand even more and was giving further thought to this in consultation with the University Grants Committee.

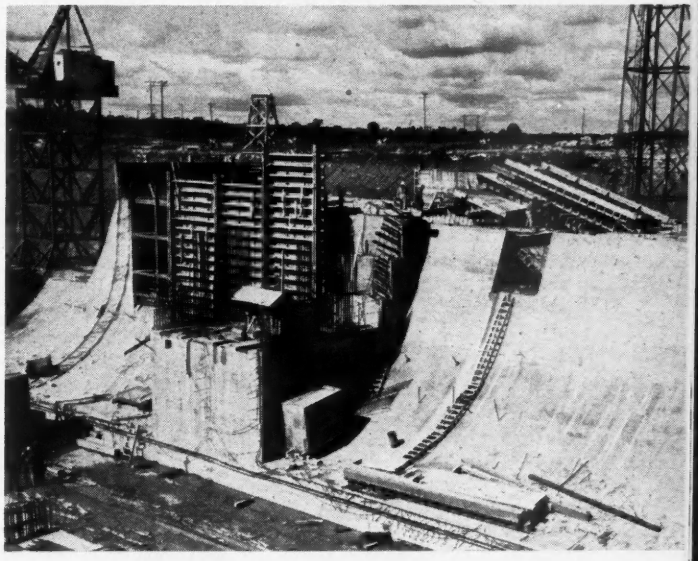
ST. LAWRENCE SCHEME

Progress of Work on Canadian Section

THE large power project which is being undertaken in conjunction with the St. Lawrence Seaway has now reached the half-way stage, with first power delivery scheduled for the summer of 1958. By then the Ontario Hydro-Electric Power Commission, which is responsible for the Canadian part of the joint project—the United States section is being constructed by the Power Authority of New York State—expects to have in operation four of the 16 units (total capacity 820,000 kW) which will constitute its share. Thereafter, the remaining units will be placed in service at approximately two-month intervals. This substantial power supply will naturally make an important contribution to Canada's economic expansion.

In the comparatively short time since a start was made on this impressive scheme in August, 1954, many complex engineering problems have had to be solved, yet work is well up to schedule. One of the first tasks was to block the north channel of the river by a cofferdam to divert the water through the channel south of Barnhart Island, and later one of the world's longest steel-cell cofferdams was constructed between the north-eastern end of the island and the Canadian mainland, sealing off a 2½-mile portion of the channel. This section was then pumped out, some 650 million gallons of water being discharged into the lower river in less than five days. Behind the steel-cell cofferdam the foundations of the main gravity-type dam were then excavated. The joint power houses form an integral part of this dam, which will be bisected by the international boundary. Other main features of the project are a dam at Long Sault to control the level of the headpond, a dam at Iroquois Point to regulate the flow from Lake Ontario and some 14 miles of dyke.

To facilitate traffic and the movement of materials and equipment to the power-house site, two sets of tunnels have been driven under the Cornwall Canal and the new diversion canal which will carry water traffic when the 1957 navigation season opens. The larger tunnels, each 16ft in diameter, carry vehicular traffic up to 22-ton diesel trucks, while pedestrian traffic, an aggregate conveyor, a



The Robert H. Saunders-St. Lawrence generating station in course of construction. The massive concrete structures seen here are chutes for diverting ice from the turbines

Aerial photograph of the site showing (A) work under way on the adjoining power houses, (B) tunnels under the new diversion canal, (C) canal closure structure, (D) excavation for the Cornwall Canal diversion and (E) part of the Cornwall dyke

pipe for blowing dry cement by compressed air, and telephone and power cables are routed through 10ft passages.

Some of the ways in which the Commission's extensive research and testing facilities have aided work on the scheme are mentioned in its latest report, which covers the Commission's jubilee year. For example, in order to obtain the large quantities of concrete aggregate required all possible sources within practical distance, both in Canada and the United States, were investigated and evaluation studies of samples were carried out, based on physical, petrographic and freeze-thaw tests. The use of manufactured sand for the first time on one of the Commission's major projects made necessary extended laboratory testing. Air-entrained concrete is being employed for all exterior surfaces and the suitability of various agents for this purpose was studied.

As the power house is of modified outdoor design, provision has had to be made for clearing snow so that emergency repairs can be carried out. Mechanical and chemical methods of snow removal were rejected in favour of buried electric heating cables.

One of the largest heat pump installations in the world will be used for heating and air-conditioning the administration and control building of the power house. The decision to adopt this system followed studies of the heat available from cooling water in the generating and transformer stations which would otherwise be wasted.

Faraday Lecture

Nuclear Energy in the Service of Man

WHEN he made the first delivery of his Faraday Lecture in the Brangwyn Hall, Swansea, this week, Dr. T. E. Allibone, Director of the A.E.I. Research Laboratories, explained the various ways in which nuclear energy could be of benefit to mankind. He did this in a simple and straightforward manner which could be easily understood by the intelligent layman, for the Faraday Lecture is not primarily intended for engineers and others with a scientific training. This annual lecture is sponsored by the Institution of Electrical Engineers to disseminate electrical knowledge to the nation.

Dr. Allibone began by describing the anatomy of the atom, after which he referred to the discovery of nuclear fission of the uranium atom under neutron bombardment in 1939, and discussed the great quantity of energy released when fission occurred. He then explained the mechanism of the chain reaction and passed on to a general survey of the principles of reactor design by which chain reactions were started and continuous heat liberated. This was followed by descriptions of a number of power reactors beginning with those at Hanford in America and Windscale in Cumberland, to reactors such as that in the American submarine *Nautilus*, the 5 MW Russian generating station and finally the Calder Hall installation, which has already been described by the *Electrical Review* in great detail.

In addition to the large power reactors, Dr. Allibone said, the small research reactor was going to play an important part in the service of man by affording an opportunity for students and research workers to familiarise themselves with the operation of reactors and to experiment with intense neutron beams. This led him to the hydrogen fusion reaction. He said that much work remained to be done in this connection and it might be many years before we had achieved a thermo-nuclear reaction, but when this had been done there would be energy to spare for as long as the human race endured, because the amount of hydrogen and heavy hydrogen in the oceans of the world was so large.

Dr. Allibone concluded by saying that as atomic energy had come in the nick of time to supply the world with heat energy in the next century and for millions of years thereafter, so the by-products, the fission products, might find a vast industrial application almost inconceivable in magnitude to-day, and the radioactive tracer elements which could be made *ad infinitum* would be available for ever to make science more exact and so improve our knowledge of chemistry and metallurgy, of mechanical, civil and electrical engineering, and possibly change the face of medicine, biology and agriculture, and so help us in the problem of feeding a world whose population doubled in a century. Above all we had something new to offer to the peoples of the under-developed and less fortunate areas of the world who would continue to look to us for assistance and example as they had done in the past.

City and Guilds Courses

IT is announced by the City and Guilds of London Institute that an advanced level course in plant engineering, for those concerned with the selection, installation, control and maintenance of mechanical and electrical plant, has been introduced and examinations will be held next year. The course is divided into three groups as follows:—(A) Mechanical power distribution, covering mechanical plant, pumping and hydraulic plant, steam plant and refrigeration. (B) Mechanical engineering generating, covering steam-raising plant and steam engines, i.c. engines, and compressors and compressed air plant. (C) Electrical engineering generation and distribution.

Candidates are required to take Group A and either B or C. The Institute's certificate in plant engineering will be accepted by the Incorporated Plant Engineers as satisfying the examination requirements for associate membership.

The Institute has also introduced a new course for electrical fitters involving, in general, three years of part-time study at a technical college. A City and Guilds examination will be held at the end of the third year, based on syllabuses in (*a*) electrical trades theory and laboratory and (*b*) drawing and calculations (with mechanics). An additional section of the course, electrical trades workshop, has to be taken.

Provision is also made for further years of study by those who wish to obtain qualifications in special electrical subjects which have a significance in local industry. Suggested subjects include armature winding, switchgear assembly and wiring, industrial electronic equipment and maintenance of power station auxiliaries.

Among matters under consideration by the Institute is a new scheme for turbine house operation and revisions of the following existing schemes:—Fuel technology, telecommunications engineering, refrigeration practice, instrument maintenance, and illuminating engineering.

VIEWS on the NEWS

By REFLECTOR

WHEN Sir Cyril Hinshelwood officially opened DIDO, the new heavy-water reactor at Harwell, last week he said that Virgil's Dido was set into a state of uncontrolled combustion by Æneas (whom he had always intensely disliked) and came to a speedy and unhappy end. The Harwell DIDO was to be quite different, and she would glow with the enduring fires of conjugal felicity. Would not Baucis, he asked, be a better name for the reactor if we must pander to classical snobbery? When talking about the chain reaction, which was one of those rare scientific facts which had captured the imagination even of the non-scientific, Sir Cyril said that one of the greatest of all chain reactions was the spread of knowledge and truth. This derived its power from human curiosity, human invention, and human desire for power in the good sense of power over nature. It needed "pure materials" in the form of well-educated men of science. It was controlled by "moderators," among others by sane economic principles. But it could also be inhibited by the "cadmium rods" of ignorant administrators, uninformed accountants and bureaucrats, for whose progressive elimination by the reform of our educational system we must pray.

* * *

An interesting nuclear theory has been put forward by an American naval scientist, Mr. Robert L. Carroll. He believes that as an atom gets colder and becomes less active its electrons gravitate towards the nucleus or its centre and are compelled to move at an accelerating pace. He thinks that if the temperature is reduced far enough the result will be that the electrons will plunge into the nucleus and disintegrate it, thus releasing its entire energy. Hitherto, nuclear fission has been caused by the penetration by neutrons from one atom of the nucleus of another. Mr. Carroll is suggesting that atomic "suicide" is the better way.

* * *

Strange goings-on in Sheffield are reported by the *Yorkshire Post*. A 71-year-old widow has stated that her mattress has sunk on either side as though two other persons were lying down and the springs creak in the morning as though someone was getting up. A man living opposite says that he knows just what she means but it is not a ghost. He often hears a sucking noise which seems to move his bed. "It is like a giant trying to breathe. It comes from nearby Neepsend Power Station." It is said that "an approach has been made to the local vicar to conduct a service of exorcism," but I should have thought that it was more a matter for the station superintendent.

* * *

In places in its area where the provision of hydro-electric power is uneconomical the North of Scotland Hydro-Electric Board is giving supplies from diesel-engined power stations. Where this system, too, is uneconomical it is supplying bottled gas. This has led to remonstrations from residents in the Torridon district of Ross-shire and an indignant letter in the *Scotsman* from one of them says:—

> "Instead of electricity the Hydro-Electric Board offers us bottled gas at special rates. Could anything be more contemptible? No doubt, the Hydro-Electric Board is doing its best for us; but need it add insult to injury by offering us more gas, of which the supply from other quarters is already conspicuously greater than the demand?"

* * *

I see from the journal *Live Lines*, produced by the Electrical Supply Authorities' Association of New Zealand, that some of the N.Z. electricity undertakings are becoming embarrassed by having to take on local gasworks. For instance, the Wairarapa Power Board is expecting that its finances will be seriously affected by its compulsory acquisition of the Carterton and Masterton Gasworks. The Board says that it had been led to believe that there would be some reimbursement from a national pool for electricity supply authorities which were being required to take over uneconomic gasworks. On the other hand, because of the present power shortage in the country, the Auckland Electric Power Board is said to be encouraging people to use gas and is negotiating for the taking-over of the local gas company.

* * *

I have commented occasionally upon the tedium of the toast lists at some electrical functions. Sixty years ago the *Electrical Review* (27th November, 1896) expressed itself rather forcibly in reporting the annual dinner of the Institution of Electrical Engineers, saying that "the toasts were few, the speeches short, and uncommonly bad." I should have had no complaint on the first two scores and the report is too brief to enable me to judge of the third. Anyhow, Dr. John Hopkinson, "the worthy President of the Institution," made an interesting point. After saying that the commercial supremacy of the British Empire was initiated by our being the first to employ, on a large scale, our coal resources, he asked whether that supremacy would continue if coal supplies failed. He doubted it and went on to point out that

> "in the Falls of Niagara there was a waste of more power than could be derived from all the coal that could be raised throughout the world and they well knew that there were many other falls in the world than those of Niagara. He ventured to say that it would be the work of the engineer in future to utilise those falls for the acquisition and transmission of power for various purposes. When that came about what would our position be? We should surely have to do one of two things—we should either have to live on our accumulations, or we should have to flit. In either case the commercial supremacy of Great Britain would have gone."

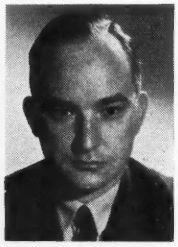
PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Central Electricity Authority has appointed **Mr. D. G. Dodds,** Ll.B. (London), as chief industrial relations officer of the Authority with effect from 1st January next. Mr. Dodds is at present secretary of the South Wales Electricity Board.

The Metropolitan-Vickers Electrical Co., Ltd., has appointed **Mr. G. H. Moule** as assistant chief engineer (heating) of the Heating and Welding Department. Mr. Moule received his technical education at Croydon Central Polytechnic and Liverpool Technical College. He gained experience in the design and development of domestic and industrial heating appliances with the Jackson Electric Stove Co., Ltd., and the English Electric Co., Ltd., and

Mr. G. H. Moule



Mr. F. R. Harris

joined M-V as a development engineer in the Heating Element Department in 1938. He was appointed engineer-in-charge of that department in 1953.

Mr. F. R. Harris, B.Sc.(Eng.), A.M.I.Mech.E., has been appointed assistant chief engineer of the company's Gas Turbine Engineering Department. He received his technical education at the City and Guilds (Engineering) College and joined M-V as a college apprentice in 1938, but on the outbreak of hostilities he was mobilised with the Territorial Army and served with the Royal Electrical and Mechanical Engineers throughout the war. After demobilisation (as captain) in 1946 he completed his course at Trafford Park and joined the Gas Turbine Engineering Department as a design engineer, being principally concerned with propulsion turbines for naval vessels. Since May of this year he has been engineer-in-charge of the order section.

The ninth annual dinner of the Foremen's Section of the Staff Association of the **Telegraph Construction & Maintenance Co., Ltd.,** and **Submarine Cables, Ltd.,** held at the Shakespeare Hotel, Woolwich, on 23rd November was attended by over 150 foremen and their guests. Mr. J. N. Dean, chairman of Telcon, replying to the toast to the company, spoke of the reorganisation taking place at the Greenwich works consequent upon the completion of the contract for the first transatlantic telephone cable by Submarine Cables, Ltd., and the more keenly competitive conditions prevailing in the cable industry. Four retiring foremen were each presented with a wallet containing money. Among those present were Dr. E. W. Smith and Mr. J. Innes, C.B., directors of Telcon, Mr. F. S. H. Lemon, O.B.E., joint managing director of Submarine Cables, Ltd., Capt. J. Marshall, master of the C.S. *Ocean Layer,* and Mr. G. T. W. Whitehead, O.B.E., director of Johnson & Phillips, Ltd.

Mr. W. S. Boone, publicity manager of Johnson & Phillips, Ltd., and **Mr. J. Read,** publicity manager, Standard Telephones & Cables, Ltd., have been elected members of the B.E.A.M.A. Publicity Committee.

Mr. W. O. Higgins and **Mr. J. H. Warburton,** M.I.E.E., have been elected to the board of T. Clarke & Co., Ltd.

The Concrete Utilities group has appointed **Mr. G. W. H. Murrell** as sales engineer for London and South East England, to assist Mr. C. A. Marques, M.B.E., M.I.Struct.E., director. Mr. Murrell was previously with E.L.E. Co. for seven years and was mainly concerned with street lighting equipment.

The North Western Branch of the **Electrical Trades' Commercial Travellers' Association** held its annual general meeting on 12th November, at the "Waggon and Horses," Southgate, Deansgate, Manchester. Tribute was paid to Mr. R. H. Corlett, the retiring chairman, for his work since the formation of the Branch, and he, in turn, thanked the officers and members of the committee for their support. The following officers were elected:—Chairman, Mr. J. B. Jones; vice-chairman, Mr. W. W. Blears; secretary, Mr. W. Smith; and treasurer, Mr. F. Foulkes. The following were elected to the Committee: Messrs. E. Hall, W. J. Connor and M. W. Mudd.

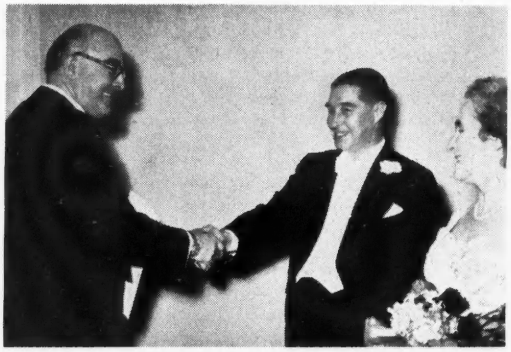
Mr. A. Webber, Associate I.E.E., has been appointed general manager of the General Cable Manufacturing Co., Ltd., and also general manager of the subsidiary, Britannic Cables, Ltd. Both companies are controlled by F. McNeill & Co., Ltd. Mr. Webber, who will take up his new appointment on 1st December, is at present assistant to the deputy chairman of the London Electricity Board.

At a meeting of the directors of Metal Industries, Ltd., on 20th November, **Mr. W. H. Garrett,** B.Sc. (Hons.), Ph.D., M.B.E., J.P., was appointed an additional director of the company.

Mr. W. F. Randall, B.Sc., A.R.S.M., M.I.E.E., F.I.M., managing director of the metals group of the Telegraph Construction & Maintenance Co., Ltd., has been appointed a director of Submarine Cables, Ltd. (owned jointly by Siemens Brothers & Co., Ltd., and the Telegraph Construction & Maintenance Co., Ltd.), to fill the vacancy caused by the death of Mr. B. H. Musgrave.

Mr. P. E. M. Sharp, A.C.G.I., B.Sc.(Eng.), A.M.I.E.E., is returning to this country at the end of December on completion of his contract with the China Engineers, Ltd. Mr. Sharp joined the Telegraph Construction & Maintenance Co., Ltd., in 1951, and later transferred to its agents in the Far East. His London address will be 46, Hyde Vale, London, S.E.10.

Lord Sempill, A.F.C., F.R.Ae.S., has been elected president of the Institution of Engineers-in-Charge for the 1956-57 session.



The Earl of Verulam (left) being received by Mr. A. H. Spindler (chairman) and Mrs. Spindler at the A.E.M.T. annual dinner-dance *(see page 980 of last week's issue)*

Mr. J. C. Farrant, previously manager of the grinding, screening and filtering division of International Combustion Products, Ltd., who for the past few years has been acting in an advisory capacity with the organisation, has retired.

Mr. C. T. Melling (president) and Mrs. Melling with Mr. and Mrs. P. Sydney at the ladies' night of the Ipswich and District Electrical Association

The **Ipswich and District Electrical Association** held its annual ladies' night on 23rd November at the Royal Hotel, Clacton-on-Sea. The chairman of the Association, Mr. H. P. Thompson, received Mr. C. T. Melling, the president, and Mrs. Melling and 230 guests, some of whom had come from as far as Birmingham, London and Norwich.

The annual dinner of the **Institute of Materials Handling** was held on 14th November at the Trocadero Restaurant, Piccadilly, London, and was attended by over 250 people. The principal guest was Mr. Harold Wilson, O.B.E., M.P., who proposed the toast of the Institute; Mr. C. Kenneth Horne replied to the toast of the guests. Other speakers included Mr. J. R. Sharp (chairman, Institute of Materials Handling) and Mr. G. C. Paterson (a founder member).

The " Mérite Culinaire " gold medal and cheque, presented by the Jackson Electric Stove Co., Ltd., for the best student in kitchen theory and practice at the Scottish Hotel School, has been won this year by **Miss J. Lynette Sinclair,** of Dalkey, Co. Dublin, Eire. Miss Sinclair, apart from her success in this particular subject, has also been awarded a Turnbull travelling scholarship of £100 for her outstanding work generally.

Sir Percy H. Mills, Bt., K.B.E., chairman of **Lancashire Dynamo Holdings, Ltd.,** accompanied by Mr. A. W. A. Dick-Cleland, joint managing director, **Lancashire Dynamo & Crypto, Ltd.,** recently made awards of certificates and cheques to five employees who have completed fifty years' service.

Davis & Timmins, Ltd., announce that **Mr. J. Martin** has been appointed stock controller, **Mr. J. H. Churnside** becomes field sales manager, and **Mr. J. Whitelock** is now senior branch manager.

Mr. J. E. Rapp has been appointed Birmingham branch manager of Berry's Electric Magicoal, Ltd. He joined the company in 1936 and has managed its Exeter branch for the past ten years.

Mr. J. E. Rapp

Mr. P. W. Kenward

He is succeeded as manager at Exeter by **Mr. P. W. Kenward,** who joined the company in 1950 from the Eastern Electricity Board. **Mr. J. F. West** has been appointed as the company's North East London and Eastern Counties representative in place of Mr. Kenward.

Mr. S. Parker has recently been appointed applications engineer to Radiovisor Parent, Ltd.

Mr. H. E. F. Taylor has been appointed executive secretary of the Radio Communication and Electronic Engineering Association.

The annual dinner of the Midlands Branch of the **Electrical Trades' Commercial Travellers' Association** was held recently at the Queens Hotel, Birmingham, and was attended by 150 members and guests. Mr. C. J. Nash (branch chairman) presided, and the guests included Mr. H. Riley (president, Electrical Industries Benevolent Association), and Mr. C. J. O. Garrard (chairman, South Midland Centre of the Institution of Electrical Engineers). During the evening a cheque for £40 was presented by Mr. Nash to Mr. Riley to augment the E.I.B.A. funds.

Mr. E. K. Cole, chairman and managing director of **E. K. Cole, Ltd.,** on 19th November presented gold

I.E.E. Sub-Centre Chairmen

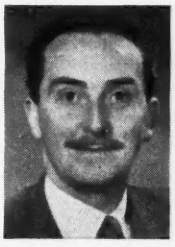
Mr. J. H. Cansdale, M.I.E.E., M.I.Loco.E. (Rugby), received his technical education at the Northampton Polytechnic, London, and the Chelmsford Technical College, and his practical training with Crompton & Co., Chelmsford. In 1927 he joined the British Thomson-Houston Co., Ltd., and was for seven years engaged in the Control Gear Engineering Department. In 1936 he was transferred to the Traction Department and in 1947 became deputy manager. He has travelled extensively in connection with B.T.H. traction business and he is the author of a number of papers and articles on electric traction. He was until recently chairman of the Electric Traction Publicity Committee of B.E.A.M.A. He was closely associated with the formation of the Rugby Sub-Centre of the I.E.E. in 1945 and was hon. treasurer from 1946 to 1955.

Mr. G. G. Nicholson, M.Eng., A.M.I.E.E., A.M.I.Mech.E. (Sheffield), is assistant chief engineer (electrical) with the Davy & United Engineering Co., Ltd., Sheffield. He was educated at the Liverpool Institute and the University of Liverpool, and served a college apprenticeship with the Metropolitan-Vickers Electrical Co., Ltd. From 1939 to 1946 he served in the Army, latterly as a captain, R.E.M.E., and on returning to the Metropolitan-Vickers Electrical Co. in 1946 he was employed in the rolling mill and control engineering departments until joining the Davy & United Engineering Co. in 1949.

Mr. W. R. Rowe, M.I.E.E. (South-Western), completed his general education at Truro School, after which he went to Faraday House Electrical Engineering College where he obtained an honours diploma. After a short period with the Electricity Commissioners he joined Edmundsons Electricity Corporation in 1936 as an assistant engineer with its subsidiary, the Cornwall Electric Power Co. Before nationalisation he held a number of progressive posts in the Engineering and Commercial Departments, being appointed district manager, West Cornwall, in 1948 and sub-area commercial officer in 1950.

Mr. J. H. Cansdale

Mr. G. G. Nicholson



Mr. W. R. Rowe

watches to thirteen employees to mark their completion of twenty-five years' service with the company.

The Data Recording Instrument Co., Ltd., announces that **Mr. C. Hardy** and **Mr. C. B. Speedy,** Ph.D., B.E. (Hons.), Graduate I.E.E., A.Amer.I.E.E., have been appointed directors of the company, which previously operated as a division of Lion Electronic Developments, Ltd.

OBITUARY

Mr. G. M. Walker.—The death occurred on 12th November, as the result of an accident, of Mr. Gordon Mabor Walker, M.I.Mech.E., M.I.E.E., deputy general manager of the Perak River Hydro-Electric Power Co., Ltd.

Mr. John Eric Steel, chairman and managing director of Steel & Co., Ltd., died on 6th November at the age of forty-nine.

Electrical Manufacture in Canada

Domestic production by electrical manufacturing companies in Canada was $1,085·5 million last year, an increase of 10 per cent over 1954, stated Mr. H. M. Turner, retiring president of the Canadian Electrical Manufacturers' Association, at the recent annual meeting of the Association. Mr. Turner, who is chairman of the Canadian General Electric Co., said that this marked the first year that the industry had passed the billion-dollar mark in production. Commenting on the current trend, Mr. Turner stated that, to date, the industry's 1956 production appeared to be running ahead of last year's volume. This trend could be attributed largely to shipments of heavy apparatus required for expansion of Canada's power stations.

Canada's 460 electrical manufacturing companies were retaining their position among the major users of Canadian raw materials. During 1955 the industry used $472 million worth of materials in its manufacturing processes, against $396·5 million in 1954. The industry spent an additional £7·8 million on fuel and electricity last year, compared with $7·4 million for 1954. Mr. R. D. Harkness, Montreal, was elected president of the Association for the coming year; he is president of the Northern Electric Co., Ltd.

Advertisement Correction

In last week's issue (supplement 122) we published an advertisement from the Merseyside and North Wales Electricity Board for third and fourth assistant engineers. The closing date for applications was given as 3rd November; it should have been 3rd December.

Lighting of the Connaught Rooms

A NEW extension to the Connaught Rooms, Great Queen Street, W.C.2, which is now open, is equipped throughout with lighting fittings and "Osram" lamps supplied by the General Electric Co., Ltd. The installation includes 65 candelabra, 33 bracket fittings and 13 ceiling fittings. The fittings are in the same decorative style as those which the G.E.C. supplied to light the banqueting rooms in the original building, to which the extension is connected.

The entrance foyer has eight Adam style candle fittings in ormolu and silk covered rods, tassels and shades. A 40ft long-bar dominates the deep carpeted floor space. Additional lighting is supplied by thirteen 3-light Adam candle brackets fixed to the fluted pillars of the room. The lower ground floor accommodates the Princes Suite comprising a banqueting room, a large reception room, an American bar, a foyer, cloakrooms and telephone kiosks. The main restaurant is lit by thirteen 2ft 6in diameter crystal glass chandeliers with metalwork finished in ormolu. Each chandelier has five candle arms with red silk covered rods and tassels and taffeta shades, and each fitting holds twelve lamps. Additional lighting is provided by four-light crystal wall brackets. The bar is lit by six chandeliers similar to those in the restaurant. An attractive decorative effect is created by two-light wall brackets which are fitted to the wall mirrors behind the bar counter.

The mezzanine floor accommodates the Edinburgh Room. It is lit by seventeen chandeliers similar to those in the main restaurant, with crystal brackets to match. Chandeliers of the same design, but with gold silk decorations, illuminate the large Cornwall Room on the second floor. These two main banqueting rooms are fitted with acoustic ceilings. Three smaller banqueting rooms on the second floor are also lit by chandeliers similar to those in the Edinburgh Room, with additional crystal brackets in the Dorset Room. Offices and workshops on the third floor are all lit by G.E.C. F.40075 "Perspex" trough fluorescent fittings. The ladies' powder rooms have lighting fittings in the form of five- and three-light crystal chandeliers with grey silk tassels, silver metalwork and pink taffeta candle shades.

In addition to the fittings in the main rooms, the G.E.C. has supplied a variety of fittings for stair and corridor lighting, and for the lighting of service rooms and cloakrooms. All the banqueting rooms are equipped with Reliance telephones connected to the main switchboard.

The G.E.C. carried out the lighting in collaboration with the architects, H. V. Ashley and Winton Newman, and the electrical wiring installations were carried out by Drake & Gorham (Contractors), Ltd.

G.E.C. lighting in the entrance foyer of the new extension

Izmir International Fair

The British Chamber of Commerce of Turkey is making tentative arrangements for the organisation of a British Commonwealth Pavilion at the 1957 Izmir International Fair, from 20th August to 20th September next. For the past eight years the Chamber has been responsible for preparing a British Pavilion in which stands were allocated to United Kingdom manufacturers and their local agents and distributors. Because of the payment and other difficulties which have faced exhibitors in recent years it will not be possible to organise a pavilion on the same basis and an endeavour is being made to enlist the support, with representative displays, of Commonwealth Governments and trade associations in addition to that of manufacturers and their local agents. It is intended to divide the pavilion so far as possible, into trade sections, country by country; both covered and open-air space will be available.

The Chamber says that it does not seek to compete with the expensive propaganda displays arranged by the Eastern Bloc countries but it does hope to put on a display in keeping with the prestige of the British Commonwealth and which will compare favourably with the pavilions of other competitors for the Turkish market. Interested parties are invited to get in touch with the Chamber's secretary at P.O.B. 190, Galata, Istanbul, Turkey.

PARLIAMENTARY REPORT

Oil Supplies

In view of the continued uncertainties of the Middle East situation, Mr. Aubrey Jones, Minister of Fuel and Power, announced in the House of Commons last week that the Government had decided to take further measures, including a statutory rationing scheme for motor fuels, to reduce oil consumption.

The broad purpose of these measures, he said, was to make good an estimated shortfall of 25 per cent in United Kingdom supplies. The measures had been designed to maintain industrial production to the maximum possible extent. Thanks to the substantial savings that could be made in ships' bunkers and by the Central Electricity Authority, he did not propose at present to increase the 10 per cent cut in fuel oil for industry. He had to warn the House, however, that further cuts in fuel might in time become unavoidable.

Mr. Geoffrey Lloyd said this statement, combined with the present coal production prospects, made an even stronger case for pressing ahead with the development of atomic energy.

Mr. Jones said he agreed entirely. That was why he would be making another statement on the subject before the end of the year.

Mr. Nabarro, commenting on the announcement in a later debate on Emergency Regulations, forecast that the policy of the last two years to encourage industry to change over from coal to imported oil was about to be reversed. Many industrial plants which had dual-burning plants would swing back to coal. Therefore, could we sustain a state of affairs in which oil and domestic coal were rationed but industrial coal was not rationed?

Mr. Darling complained of the 10 per cent cut in oil supplies to opencast mining machines, saying this would be dangerous.

Mr. David Renton, Parliamentary Secretary, Ministry of Fuel and Power, said there were already arrangements for the distribution and allocation of industrial coal. It was a fair and satisfactory system and he hoped it would continue to operate. The Government had asked contractors doing opencast mining to make the economy of 10 per cent overall in their activities and it was hoped that it could be made without interfering with opencast production. The Government would, however, watch the position very carefully.

Mr. Darling asked whether the Minister would give a general direction to the C.E.A. to convert coal-fired and oil-fired generating plants to gas turbine propulsion, using producer gas wherever this was practicable.

Mr. Jones replied that gas turbines had not yet proved themselves efficient generators of electricity on a large scale.

Electricity in the Hebrides

Mr. J. Henderson Stewart, Under-Secretary, Scottish Office, told Mr. M. K. MacMillan that approximately 80 per cent of the total population of the islands of Lewis, Harris, South Uist, Benbecula and Eriskay were now supplied with electricity by the North of Scotland Hydro-Electric Board. The Board was not able to say when all potential consumers in these islands and in Barra and North Uist would be connected

Mr. MacMillan asked if this was not a very mean economy considering the fact that in the Island of Harris the poles and wires were already up in some villages and went past the doors of the houses, many of which were wired.

Mr. Stewart admitted that the need for national economy had had some effect, but said that the completion of the programme in these islands and the extension to Barra and North Uist must be governed by the financial position of the Board as well as the request of the Government to reduce capital expenditure.

Food Hygiene and Refrigeration

In reply to Mr. Palmer, Miss Hornsby-Smith, Parliamentary Secretary, Ministry of Health, said that refrigeration was not specifically required by the Food Hygiene Regulations, although artificially cooled storage might in some circumstances be desirable or necessary. The questions of hire purchase restrictions and purchase tax were matters for the President of the Board of Trade and the Chancellor of the Exchequer.

Mr. Palmer said that this country had fewer refrigerators installed per head of the population than almost any other country in Western Europe and asked for the financial and health policy of the Government to be directed towards encouraging their use.

Motor Vehicle Electrical Equipment

Mr. Peter Thorneycroft, President of the Board of Trade, announced that among the subjects he would refer to the Monopolies Commission for investigation and report in the near future would be the supply of certain electrical equipment for motor vehicles.

Legislation Against "Dumping"

The Customs Duties (Dumping and Subsidies) Bill, which was read the first time, gives the Government powers, in order to assist in the maintenance of international fair trade practices, to take action against dumping and the giving of subsidies on goods imported into this country.

The Bill will give the Board of Trade power to impose additional customs duties on imports of goods of any description, where they are satisfied that those goods have been dumped or subsidised and that it is in the national interest to do so. The power to impose these duties will be exercised by Order, subject to Affirmative Resolution in the House of Commons.

There are provisions for giving relief from duty, and for the allowance of drawback of duty on goods subsequently exported, in appropriate cases.

Improved Pensions

Mr. Palmer asked the Minister of Fuel and Power if he was now able to make a statement on retrospective payment of the pension improvements approved by him for ex-company pensioners in the electricity supply industry.

Mr. Aubrey Jones said he had agreed that the improvement should take effect from 1st November, 1955.

Mr. Palmer also asked the Minister whether he had yet approved the comprehensive scheme for improvements in the pensions of electricity supply pensioners submitted to him by the Central Electricity Authority.

Mr. Jones said he had now received the Authority's proposals. He was considering them and would give his decision with the least possible delay.

Technology Diploma

In reply to Mr. Tiley, the Minister of Education (Sir David Eccles) said that after considering this matter again the National Council had reaffirmed its decision to call the new award the Diploma in Technology.

Colour Television

In reply to Mr. Woodburn, the Postmaster-General (Dr. Hill) said that, together with other problems, the international aspect of colour television was now being examined by the Television Advisory Committee.

Freight Handling

When Lord Forbes raised the subject of the British Productivity Council's review of freight handling in the House of Lords, he said that one of the unsolved problems was the protection of goods during shunting operations. The most promising line of development, he thought, was something like the system used on the U.S.A. Southern Railway. There, shunting was done by means of a gradient and electronics. First, a radar device evaluated the rollability

of the wagon, taking into consideration wind, speed, size and weight; then an electronic computer automatically regulated the braking of the wagon and so ensured smooth coupling.

The Earl of Selkirk, Chancellor of the Duchy of Lancaster, replying for the Government, said that an electronic installation of the kind Lord Forbes had described had been working in the Thornton marshalling yards in Fife.

Patents Bill

In the House of Lords the Patents Bill was given a second reading. Lord Mancroft, Under-Secretary, Home Office, explained that it provided power for the Board of Trade to prescribe by Order, from time to time, the period during which applications for patents must be put in order for acceptance, although this period could not be less than one year or more than four years. Because of the shortage of examiners, although in 1956 more than 29,000 complex specifications would be received only about 26,000 would be disposed of. Under the Patents Act, 1949, the period in which a patent was required to be put in order for acceptance was 12 months but power had been given by the Comptroller-General to grant extensions of time to prevent patent applications from lapsing. This power would lapse with the passing of the Bill.

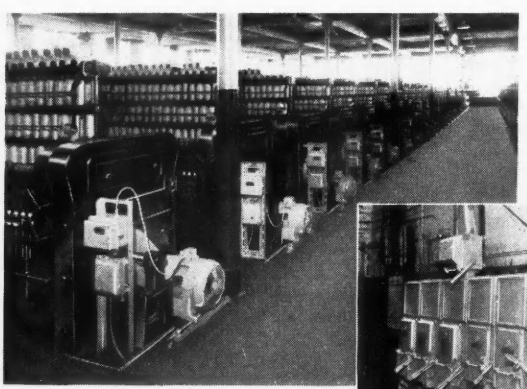
It was intended, initially, to lay down that the period in which applications must be put in order should be 3½ years, which the Chartered Institute of Patent Agents agreed was a reasonable period at present; this period would come into force when the Bill became law. If the Government's measures to improve recruiting succeeded, the period could be shortened by Order; similarly, if they failed, the period could be lengthened to four years.

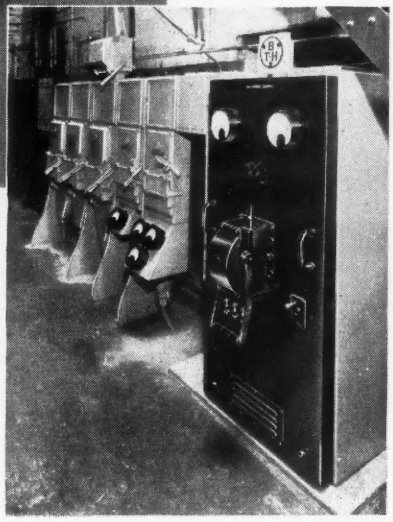
Lord Silkin commented that it was disturbing and shocking that people who applied for patents should have to wait 3½ or perhaps 4 years to get approval. In the interval much valuable production could be lost.

Lord Mancroft replied that the Government had initiated a recruiting drive among graduates and undergraduates, asking them to make a career at the Patents Office. The salaries had recently been revised so that new recruits would start at £605 a year, rising to £1,345 in a scale which contained two advances, and one promotion would take them to £2,000.

Textile Mill Conversion

TWO years ago the Sandbrook Spinning Co., Ltd., Orrell, near Wigan, found it necessary to consider a major overhaul of the main driving engine and the coal-fired steam raising plant at its mill. The British Thomson-Houston Co., Ltd., was called in to advise on a suitable scheme. The change-over from single-steam to multiple-unit electric driving was agreed upon, and the transition was planned to take place over a period of two years so that there would be no interference with the normal output.





Left: 10 h.p. and 12½ h.p., 1,440 r.p.m. s.c. motors driving ring frames. Below: The main supply is taken from transforming plant to an air-break l.v. switchboard of 25 MVA rupturing capacity

In all, 124 electric drives—each consisting of a motor and its associated control gear—were installed in place of the single 650 h.p. steam engine. Individual driving has been adopted wherever possible with a power factor correction capacitor fitted to each motor. In general, the motors are fitted on slide-rails near the driven machines, but in cases where this has proved to be impracticable the drive is mounted on a suitable bracket on the machine itself. Direct-on-line contactor starters have been employed in 120 drives ranging in size up to 12·5 h.p. The largest single unit is an 85 h.p. mill-type motor for driving the carding engine line shaft which transmits to 36 carding machines.

The main electricity supply is taken from the system of the North Western Electricity Board through a 750 kVA, 6,600/440 V transformer to a B.T.H. air-break l.v. switchboard of 25 MVA rupturing capacity. The main incoming panel is a metal-enclosed 1,200 A truck-type equipment with a 200 A switch and fuse unit feeding the lighting circuits. The power feeders are controlled by a 200 A and three 400 A switchboards of similar design.

Cabling from the main switchboard to the various distribution boards has been carried out in p.i.l.c.s.w.a. three-core or four-core cable, with "Pyrotenax" or v.i.r. cables in conduit for the local circuits.

The conversion was completed earlier this year and it is reported that the management is fully satisfied with the operation of the mill and that a considerable saving has been made in running costs.

Mr. William Heaton was the electrical contractor responsible for the complete installation which included the motors, control gear, switchgear and cabling, while the millwrighting was sub-contracted to Thos. Wainwright & Sons, Ltd., Stalybridge. The mill manager is Mr. G. Smith.

Congo Power for Rhodesian Mines

Power from Le Marinel hydro-electric station on the Lualaba River, in the Belgian Congo, is now being supplied to mines in the Northern Rhodesian Copperbelt through the Rhodesian Congo Border Power Corporation's central switching station at Kitwe. Announcing this, the Corporation says that the imports, initially amounting to some 20 MW, will be increased as other sections of the plant are commissioned. The supply will augment the power generated by the mining companies and will help to bridge the gap between plant capacity and demand until supplies are available from the Kariba hydro-electric project. Le Marinel power station and the 320-mile transmission line operating at 220 kV have been completed in just over three years.

INDUSTRIAL NEWS

Sir Claude Gibb on Nuclear Power

Sir Claude Gibb, chairman of C. A. Parsons & Co., Ltd., speaking at the recent annual dinner of the Institute of Directors (Northern Counties Branch), said it was fantastic for Britain to build its industrial future on supplies of oil. He declared that the Government's nuclear power programme should be increased to provide for, not 12, but 112 new nuclear power plants.

Sir Claude said that Great Britain's oil supplies could be interrupted at any time by any minor despot, and it would cost only £150 million to double the present nuclear power plant programme. It had been estimated that during the next ten years the country's oil needs would rise by 70 per cent, and imports from the Middle East would have to be increased by 15½ per cent. He added that one ship carrying uranium oxide to Britain, carried as much potential power as 150 ships of a similar tonnage carrying oil. This illustrated the vital need for Britain to build additional nuclear power plants.

All-Electric Homes

Editorial Services, Ltd., 32, Great Queen Street, London, W.C.2 (public relations advisers to the B.E.A.M.A.), are forming a panel of owners of all-electric homes in different parts of the country in order to obtain for manufacturers information relating to the cost of running these homes.

It is hoped to obtain particulars of the running costs during the past six months and the ensuing six; what electrical appliances are installed and what use is made of them; and some account of the advantages obtained from an all-electric home. Owners of all-electric homes are asked to communicate with Editorial Services. All information will be treated as confidential.

Radiant Heater Factory

An increasing demand for the "Radisil" radiant heater (described in the *Electrical Review*, 9th March, 1956, page 367) has led the manufacturers, Hanovia (Lamps Division of Engelhard Industries, Ltd.), to erect a new factory at their premises in Bath Road, Slough, Bucks. The factory, which was officially opened by the Mayor of Slough, Alderman R. Taylor, J.P., on 16th November, will be devoted entirely to the production of "Radisil" heaters, enabling the output of these to be increased to more than 6,500 per week.

It is a single-storey building, with a floor area of 10,000 sq ft, and is the first to be entirely warmed by "Radisil" heaters, providing an interesting example of the efficiency of the unit. Although a large window space is involved the installation has proved most successful, a maximum of 120 kW being sufficient to heat the entire working area. The installation comprises eighty 4ft 1·5 kW heaters, fixed alternately with the fluorescent lighting fittings on the ceiling. A feature of the heater's design is the reflector housing which can be adjusted through an angle of nearly 120 deg. This ensures that radiation is "beamed" down to the working areas without being affected by cross draughts. Operating costs have consequently been kept to a minimum since localised heating in this manner is less expensive than warming up the entire air mass in the factory.

The company announce that coincidental with the opening of their new factory they are introducing three new models. These are the model 11, rated at 1·5 kW or 2 kW, for domestic use; and two industrial types, model 20 (500 or 750 W) and model 21 (1·5 or 2 kW).

New Hanovia radiant heater factory at Slough

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £272 5s 0d
Fire Refined 99·7%	ton £271 0s 0d
Fire Refined 99·50%	ton £270 0s 0d
COPPER Tubes ..	lb 2s 7½d
Sheet	ton £342 0s 0d
H.C. wire and strip ..	ton £305 0s 0d
LEAD, English ..	ton £117 10s 0d
Foreign	ton £116 0s 0d
MERCURY	flask £83 10s 0d
TIN, block (English) ..	ton £844 0s 0d
ZINC, G.O.B. Foreign	ton £101 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 2d
Sheet	ton —
Wire	lb 2s 10⅛d
PHOSPHOR BRONZE Wire	lb 4s 3½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 32½d—32¾d

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 17th November is deemed to be 175s.

The "cost of materials" figures are: For electrical machinery and equipment the Board of Trade index figure published on 17th November is 185·8. For turbo-generating and allied plant: Materials used in mechanical engineering industries, 177·8, blast furnaces and iron and steel melting and rolling (40 and 41), 167·3. The price of ¼in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 16th November) is 50d per lb.

Instruments, Electronics and Automation Exhibition

An exhibition of instruments, electronics and automation is being held at Olympia, London, from 7th to 17th May next. It is being organised by Industrial Exhibitions, Ltd., and is being promoted by the following associations:—The British Electrical and Allied Manufacturers' Association; the British Industrial Measuring and Control Apparatus Manufacturers' Association; the British Lampblown Scientific Glassware Manufacturers' Association; the Drawing Office Material Manufacturers' and Dealers' Association; and the Scientific Instrument Manufacturers' Association of

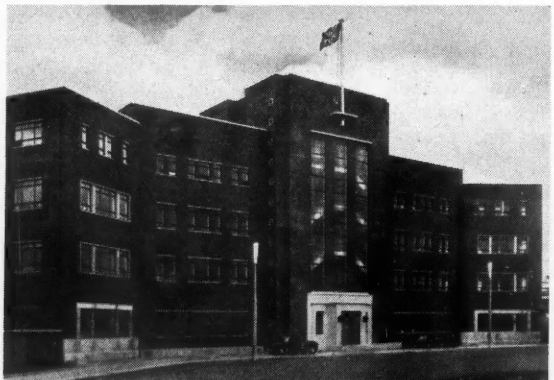
Great Britain. The number of manufacturers who have booked space is very large, and an exhibitors' ballot was held yesterday (Thursday) at the Connaught Rooms, London.

Ferguson, Pailin's New Premises

The latest phase in the expansion plans of Ferguson, Pailin, Ltd., switchgear manufacturers, Manchester, is the erection of a new four-storey building to accommodate engineering, design, drawing office and research department staffs. Situated some distance from the main works where 1,600 men are employed, the building has been designed to permit the addition of extension wings to cater for developments in the company's production programme. It represents the largest single building project completed since the construction of the main works in 1923.

Mr. J. R. Wilkinson, managing director, welcoming representatives of the Press, who made an inspection of the works and offices on 22nd November, said that the company faced the future with confidence, and had made steady and consistent progress during the last six years, but in common with all other manufacturers had to anticipate difficulties for the next year or two.

The party in their tour of the works were shown the manufacture of a wide range of switchgear for power supply and industrial applications, including a large unit which is on order for an important oil plant in the Middle East. It is due for shipment to Kuwait.



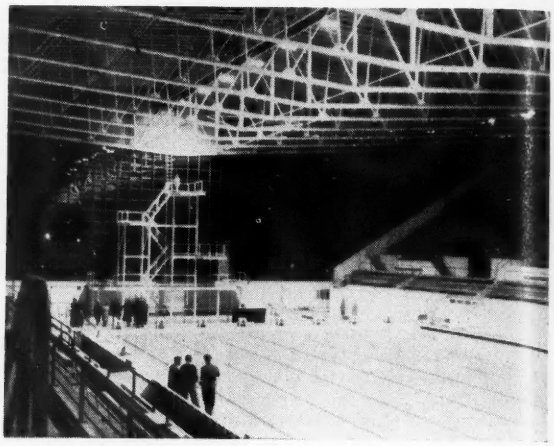
The new drawing office, engineering and research building of Ferguson, Pailin, Ltd.

Ideal Home Exhibition

The *Daily Mail* Ideal Home Exhibition, 1957, will be held at Olympia from 5th to 30th March.

Olympic Games Swimming Pool

The swimming and diving stadium specially built at Olympic Park, Melbourne, for the Olympic Games will accommodate 5,500 people. The illumination of the pool is by twenty-eight Benjamin high bay units, each fitted with 1,500 W lamps. Specially designed for such installations, these lighting fittings are "Brytal" anodised inside and high temperature stoved grey enamel outside. The reflectors are of heavy gauge aluminium and "Saaflux" heavy duty tops are fitted which prevent moisture and dirt from entering the top flange chamber. They also give greater corrosion resistance. The lighting units were supplied by the British General Electric Co. Pty., Ltd.



Benjamin reflectors installed at Olympic Games swimming stadium

Earth Return System

Among the numerous subjects dealt with in the first number of *Live Lines*, the newsletter of the Electrical Supply Authorities' Association of New Zealand, is the single wire earth return system of distribution. It is stated that the system was first adopted in the Tauranga Electric Power Board area and much of the original installation is still operating. It has since been employed in a number of other areas in New Zealand.

The Victorian State Electricity Commission, Australia, has installed hundreds of miles of s.w.e.r.s. in the past three or four years, thus achieving considerable economy, reliability and better service. It has been claimed that this type of distribution is subject to fewer faults in heavy weather than the three-wire system.

Compound Generator

After many years of research a Netherlands company, Heemaf, N.V., of Hengelo, has designed a three-phase compound generator which, without using a separate exciter, has a constant terminal voltage with varying loads. The energising power for the generator cannot, however, be drawn from it direct, as the generator supplies a.c., and it has to be powered by d.c.

Regulation or compounding is effected by means of a compounding transformer, which ensures that the exciting current is properly affected by the loading current, i.e., according to the voltage and phase shift. For self-excitation a selenium rectifier is used which converts the a.c. to the d.c. required for energising the poles.

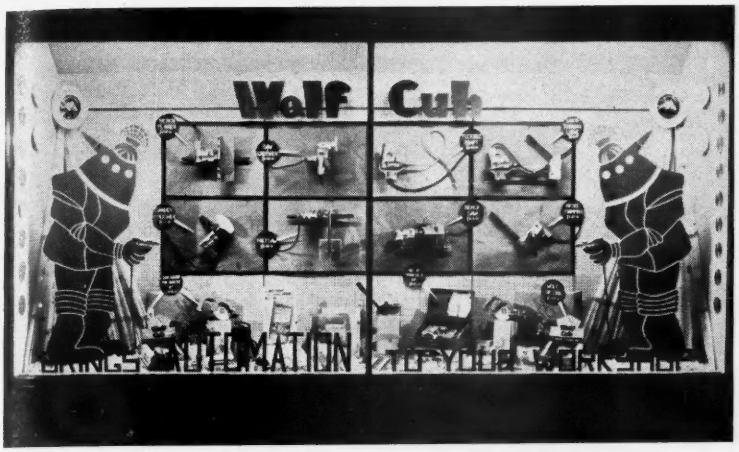
The generator has the same features as the d.c. compound generator, but there are no separate excitation and regulation. No shunt winding is necessary—indeed it is undesirable—and the machine is simple, sturdy, reliable and stable. High regulating speed, high brief resistance to overstress and high current yield are other features of the machine.

British Railways Exhibition

An exhibition of special interest to all sections of the British Transport Commission is being held at the showrooms of Allied Ironfounders, Ltd., 28, Brook Street, W.1, from 5th to 14th December. The exhibition has been designed to display a cross-section of the appliances manufactured by Allied Ironfounders with particular emphasis on those that are suitable for use in public waiting rooms and offices; signal boxes; platelayers' and crossing gate huts; domestic property; welfare centres at engine sheds; garages and works; hotels and restaurants. Heating and cooking apparatus will also be shown.

A.D.A. Publications

The Aluminium Development Association has published a Directory of Members (1956-57), giving the names of the members of the Council, a brief statement of the constitution and objects of the Association and the names, addresses and other particulars of its member companies including, where applicable, associate or subsidiary companies. In each case a short description is given of the activities and products of the company. By means of an index of products classified under "Aluminium" and "Aluminium Alloys" readers are



The winning window display in the Wolf Electric Tool competition

referred to all member companies producing any particular product.

The Association has also issued a booklet giving details of the main series of technical publications issued by it. Both these publications are obtainable, free, from the Association, 33, Grosvenor Street, London, W.1.

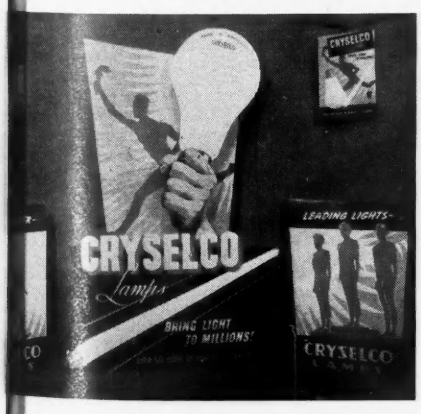
Electric Tool Window Dressing Competition

The second national window dressing competition organised by Wolf Electric Tools, Ltd., for the hardware and tool trade has been won by Robert Membery, Ltd., builders' merchants, Bath, who will receive a cheque for £250. The second prize (£100) was awarded to Hoopers (Portsmouth), Ltd., Portsmouth, the third prize of £50 being awarded to Garvie & Syme, Perth. In addition, 15 area prizes of £20, and 66 of £5 were also awarded. Mr. R. F. Hatto, sales director of Wolf Electric Tools, Ltd., will present the national prize winners with their awards.

Topical Window Display

The accompanying picture shows a lamp window display which Cryselco, Ltd., is issuing this season. A topical note is given to the display by linking it up with the Olympic Games which are being held in Melbourne.

New Cryselco window display



Lighting Applicatios

The Lighting Division of Philips Electrical, Ltd., has published the first number of a new "Lighting Application Bulletin." Its aim is to assist contractors, retailers and shopfitters in the handling of the smaller type of lighting project for different types of businesses. The first number of the series deals with lighting for grocery and provision shops.

Turbine for Steel Works

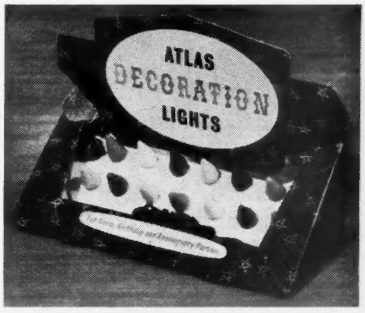
An order has been placed with Richardsons Westgarth (Hartlepool), Ltd., for what is believed to be the highest pressure steam turbine yet to be manufactured in Great Britain. The unit will be installed at the Margam "B" power station of the Steel Company of Wales, Ltd., and will be built for a live steam pressure of 3,000 lb/sq in and a temperature of 1,050 deg F. The exhaust steam after reheating will be discharged into the existing 600 lb/sq in steam main. A maximum quantity of 240,000 lb/hr of steam will be supplied from a Benson boiler and under these conditions an alternator output of 9,250 kW will be available for the steelworks. A special design of double casing turbine will be adopted on account of the high pressure and temperature and the unit will be designed in conjunction with Brown, Boveri & Co., Ltd., of Switzerland, with whom Richardsons Westgarth (Hartlepool), Ltd., have long-standing design agreements. The manufacture will be carried out at Hartlepool.

Oil Engine Agreement

The National Gas & Oil Engine Co., Ltd. (one of the companies of the Brush Group), has entered into agreements with Alan Muntz & Co., Ltd., under which they are licensed to manufacture the Pescara free piston engine system. Gas generators with cylinder diameters of 6in and upwards are covered by these agreements and production of the engines will be undertaken at the Ashton-under-Lyne works of the National Gas & Oil Engine Co. One size of free piston gas generator will be produced at present. This is the model GS34 developed by S.I.G.M.A. in France, which can provide 1,000 s.h.p. in a single unit and up to 16,000 s.h.p. by the use of multiple units. Engines produced by the National Company may be sold under the terms of the agreements in the United Kingdom and the countries of the British Commonwealth for industrial and locomotive purposes, and also for certain marine purposes. Additional sales rights have also been granted for stationary installations in a number of foreign countries.

Atlas Decoration Lights

Thorn Electrical Industries, Ltd., is now supplying "Atlas" decoration lighting sets in a new and attractive display pack. The new box, cheerfully designed in red, green, blue and yellow, is triangular in section and when open forms an excellent display-piece for shop window or counter.



"Atlas" Christmas decoration lighting set

Each set contains twelve lamps in mixed colours, ready wired with b.c. plug, and one spare lamp. The price of the set is 20s including tax.

Petbow Silver Jubilee

The October number of the *Petbow Magazine* marks the silver jubilee of Petbow, Ltd., which began business in Willesden twenty-five years ago. A number of the articles and notes in this issue touch upon the company's history and development.

London Trolley-Buses in Penang

The George Town (Penang) Municipal Council has until recently operated single-decker trolley-buses only, but in order to provide increased accommodation it has now acquired six former London Transport double-decker trolley-buses for operation in the city. These have undergone some modifications to suit local conditions.

The Council has had some difficulty in obtaining an officer to run the Transport Department, and it has now

One of the former London Transport double-decker trolley-buses now in operation in George Town, Penang

appointed a locally domiciled honours graduate of the University of Malaya as a pupil transport manager. He will train with a British transport undertaking so that he can take over the responsibilities for the George Town transport undertaking at the beginning of 1959. In the meantime the Council is endeavouring to secure the secondment of a transport manager from one of the transport undertakings in Great Britain.

An interesting sidelight of the operation of the double-decker buses in George Town is that each bus has two conductors—a man downstairs and a girl on the top deck.

Scottish Cable Contract

The South of Scotland Electricity Board has placed a contract valued at over £1,000,000 with Scottish Cables, Ltd., for paper insulated cables in connection with the Board's programme of expansion of its distribution network. Delivery is due to begin early next year.

British Oxygen Training School

A new craft training school for apprentices employed by British Oxygen Engineering, Ltd., was opened at Angel Road, Edmonton, on 15th November by Mr. R. Carr, M.P., Parliamentary Secretary to the Ministry of Labour. The building comprises a machine shop, fitting sections and a lecture room. It caters for 45 to 50 students.

Sign Design Competition

In our issue of 5th October we gave particulars of the second illuminated sign design competition sponsored by the Electrical Sign Manufacturers' Association. The names of the judges have now been announced. They are as follows:—Lord Luke (president, Advertising Association); Professor Sir Patrick Abercrombie (Professor Emeritus of Town Planning, London University, and chairman of the Council for the Preservation of Rural England); Sir George Pepler (president, Town Planning Institute Summer School); Mr. Arthur B. Hall (president, British Motor Trade Association); Mr. F. C. Woodward (president, Radio and Television Retailers' Association); and Mr. F. F. Newlands and Mr. K. J. Oldham (chairman and vice-chairman, respectively, of the Electrical Sign Manufacturers' Association).

Japanese Engineers' Visit

The delegation of Japanese engineers which is visiting Britain to make a detailed study of our atomic power progress were guests recently at the London offices of Mitchell Engineering, Ltd., where they learned of the company's developments in the design and construction of nuclear power plants in conjunction with their American associates, A.M.F. Atomics, Inc. The members of the delegation included Mr. Shiro Hoki (deputy director of the Science and Technical Agency, Japanese Atomic Energy Bureau) and Mr. Tamaki Ipponmatsu (managing director, Kansai Electric Power Co.).

Trade Announcements

Mr. J. R. Boraston has been appointed Yorkshire representative of **Higgs Motors, Ltd.** He joined the inside sales staff of the company in 1954. Mr. A. W. Lowry has been appointed to cover the company's South Wales area. He recently joined the staff after serving with Guest Keen Baldwins Iron & Steel Co., Ltd., Cardiff.

The Plessey group of companies has established an office at Singel 160, Amsterdam C, which will form an integral part of **Plessey International, Ltd.,** the group's overseas marketing organisation, and will supervise Plessey interests in Northern and Central Europe. Mr. E. A. Springett has been appointed territory manager.

The Midland office of **Marconi Instruments, Ltd.,** has been transferred to 24, The Parade, Leamington Spa. The new premises include two showrooms, one for X-ray and electromedical products, the other for telecommunications equipment.

The **Grubb Engineering Co., Ltd.,** has appointed Leslie Maynard, Ltd., 306a, Fulham Road, London, S.W.10, as its sole agent to the electrical wholesalers in the Greater London area and the Home Counties.

Mr. D. Christie has been appointed sales representative with the domestic appliance and television division of the **English Electric Co., Ltd.** He will cover the South Eastern territory of Scotland, will be based in Edinburgh, and will work with Mr. J. C. Wood, the division's Scottish area manager.

The London office of **H. A. Birch, Ltd.,** is now at 1-5, Northolt Road, Harrow, Middx. The telephone number is unchanged.

Educational

A course of nine lectures on "High Quality Sound Reproduction" will be held at the Manchester College of Science and Technology commencing on 7th January next. Particulars can be obtained from the Registrar of the College, Sackville Street, Manchester, 1.

Full-time courses on "Radioisotopes and their Uses" begin at the Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, on 14th January next. Applications for enrolment forms should be made to the secretary of the college.

Change of Address

The Institution of Chemical Engineers has moved to 16, Belgrave Square, London, S.W.1 (telephone: Belgravia 3647).

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 7th December:—

STELLAPHONE. No. 752,996. Class 9. Radio, telegraphic, telephonic, television, radiolocation, electronic and sound transmitting, receiving, recording, reproducing and amplifying instruments, all sold complete; and gramophone pick-ups, etc.—Stella Lamp Co., Ltd., 37-39, Oxford Street, London, W.1.

No. 754,256 (design). Class 9. Electrical apparatus and instruments, coin or counter freed apparatus, and luminous advertising apparatus, etc.—Auto-Projection Engineers, Ltd., Hong Kong Works, South Way, Exhibition Grounds, Wembley, Middx.

AERIALITE UNI-LEAD. No. 756,376. AERIALITE UNI-LEADEX. No. 756,377. Class 9. Aerials.—Aerialite, Ltd., Castle Works, Stalybridge, Ches.

PLESCAN. No. 756,401. PLESGEL. No. 756,402. PLESMIN. No. 756,404. PLESMOLD. No. 756,405. PLESPAC. No. 756,406. PLESSEAL. No. 756,407. PLESTUBE. No. 756,408. PLESWAX. No. 756,409. All Class 9. Electrical condensers.—Plessey Co., Ltd., 56, Vicarage Lane, Ilford, Essex.

OVERSEAS ELECTRICAL TRADE

Recovery in Exports in October

THE October figures for British electrical exports, given in the Board of Trade returns, show a welcome recovery after the fall recorded in the preceding month. The value at £19·2 million was nearly £4 million higher than September, and £1·6 million better than that for October, 1955. The total value of exports for the first ten months of this year was £181 million, as compared with £157 million for January-October, 1955.

Notable increases were shown in the generating plant and motors group, exports of which were valued at £3,050,412 in October, against £1,931,459 in September, and in the converting machinery, transformers, etc., class which rose from £1,810,343 in September to £2,432,567 last month. Other groups which showed increased values in October were radio and electrical apparatus (from £2,974,086 to £3,279,776), telegraph and telephone material (from £1,406,310 to £1,735,854) and cables and wires (from £2,335,998 to £2,692,053).

Increased shipments to Canada accounted largely for the rise in value of generating plant exports, that country importing plant valued at £613,775. The next country in order of importance was India, which purchased plant valued at £276,737. Third place was taken by South Africa with a value of £231,494. In the converting machinery and transformers group, the three leading purchasers were Australia with a value of £391,116, India

TABLE I.—ELECTRICAL EXPORTS

Class	October, 1956	Ten months ended October, 1955	Ten months ended October, 1956
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	165,511	1,159,187	1,438,473
Ditto, 10 to 65 kW	268,756	1,285,892	1,434,387
Ditto, 65 to 200 kW	116,183	1,167,002	1,290,020
Ditto, over 200 kW	353,321	4,395,621	2,989,905
Spark ignition engine driven	23,216	216,090	294,953
Steam turbine driven	18,462	1,236,237	1,084,747
Hydraulic turbine driven	—	368,804	51,786
Other prime mover driven	15,790	285,806	524,676
Generators, not exceeding 200 kW	146,525	1,275,351	1,227,905
Ditto, over 200 kW	87,938	996,582	784,302
Parts of generators	531,335	4,399,620	4,938,332
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	213,686	2,054,458	1,914,153
Over ½ but under 1 h.p.	55,016	639,030	555,805
1 h.p. to 250 h.p.	490,476	3,795,040	4,181,575
Over 250 h.p.	100,879	737,860	726,795
Railway, tramway and trolley-bus motors complete and parts of all motors	182,037	1,571,125	1,589,582
Motor starting and controlling gear	281,281	1,994,534	2,388,404
	3,050,412	27,578,239	27,415,800
Converting machinery	31,535	442,212	311,898
Mercury-arc rectifiers	74,519	710,726	711,902
Transformers for lighting, heating and power (incl. coils)	877,537	9,128,216	10,207,978
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	308,177	2,657,269	2,851,554
Ditto, other	1,140,799	10,084,879	11,357,702
	2,432,567	23,023,302	25,441,034
Primary batteries:			
Lighting	102,964	720,873	834,905
Radio	368,888	1,735,153	2,583,202
Other	41,504	373,078	426,118
Parts (excl. carbons)	39,539	335,445	381,180
Lamps:			
Filament, exceeding 24 V	100,020	893,896	983,048
Ditto, under 24 V	32,352	306,939	306,912
Arc lamps and searchlights	17,031	129,712	200,589
Discharge lamps, fluorescent tubes, etc.	101,297	687,653	737,806
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	16,837	192,157	253,756
Cathode-ray tubes	49,157	104,986	370,167
Other valves (not X-ray)	219,057	1,778,147	2,151,701
Parts (excluding glass bulbs)	11,595	232,696	105,473
Radio and television transmitters	19,354	626,534	923,909
Commercial radio and radar equipment	1,651,627	9,947,725	12,681,478
Domestic radio receivers, mains	154,882	1,571,045	1,318,342
Ditto, battery	46,539	674,441	724,612
Ditto, other (incl. car)	22,286	192,952	242,302
Radiograms	34,359	445,626	355,659
Television sets	72,659	264,671	444,449
Public address equipment	82,328	796,777	845,465
Sound reproducing app., n.e.s.	56,397	260,710	353,375
Components and parts, n.e.s.	842,699	5,939,104	6,962,517
Telegraph and telephone installations	566,375	6,350,434	6,023,986
Telephone instruments, separately consigned	168,733	984,736	1,413,297
Telegraph and telephone parts	736,232	4,752,069	6,384,823
Line apparatus for long distance commun.	264,514	754,476	2,153,062
	1,735,854	12,841,715	15,975,168

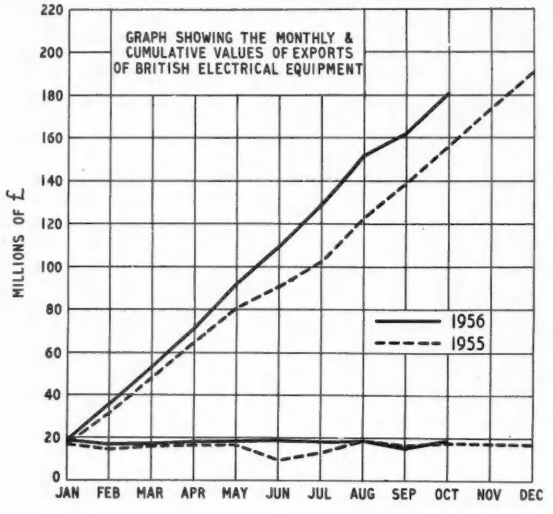
Class	October, 1956	Ten months ended October, 1955	Ten months ended October, 1956
	£	£	£
Cookers	78,007	1,142,596	766,461
Toasters	52,582	322,702	281,865
Other cooking apparatus	39,113	306,710	360,090
Parts and accessories	83,538	712,913	791,162
Space heating appliances	48,633	358,844	357,459
Water heating appliances	36,456	328,590	333,258
Other heating appliances	33,917	280,575	360,692
Parts and accessories	62,987	729,143	636,142
Irons	106,277	1,009,894	932,361
Arc welding equipment, a.c.	53,630	333,797	529,414
Ditto, d.c.	27,198	288,681	433,955
Resistance welding equipment	13,107	188,473	174,226
Electric furnace plant	39,644	526,043	577,080
Magnetos, ignition	34,630	162,563	273,783
Sparking plugs	198,375	1,532,380	1,700,490
Elec. appliances for aeroplanes, n.e.s.	234,191	1,879,773	2,136,400
Ditto, for motor vehicles, n.e.s.	399,738	3,089,909	3,590,778
Ditto, for cycles, n.e.s.	48,729	716,157	599,260
Signalling app. (incl. traffic signals)	94,165	500,119	672,873
Industrial radio-frequency equipment	15,359	145,856	121,028
Bell app. (not telegraphic or telephonic)	9,969	85,559	87,984
Instruments, commercial	170,070	1,435,829	1,735,944
House service meters (including parts)	168,591	1,265,352	1,702,532
Electro-medical apparatus (not X-ray)	43,090	495,201	638,252
X-ray apparatus (excl. tubes and valves)	44,344	634,608	644,822
Vacuum tubes	25,650	214,132	284,704
Ceiling fans, complete	76,624	805,281	1,044,147
Desk fans, complete and parts of desk and ceiling fans	49,994	308,136	390,008
Vacuum cleaners	163,352	1,304,520	1,439,168
Floor polishers	79,096	969,654	753,620
Food mixers	67,361	520,351	613,942
Hair clippers and dry shavers	87,093	871,304	743,746
Other portable appliances	19,161	422,448	291,604
Parts	118,316	830,068	1,119,061
Portable elec. tools (not saws) and parts	300,285	1,855,035	2,199,207
Cables and wires:			
Telegraph and telephone, submarine	100,530	641,574	1,687,117
Ditto, other	776,697	5,199,841	8,330,963
Cotton, silk or art. silk insulated	31,231	486,037	495,847
Enamel, glass or asbestos insulated	106,933	721,993	1,005,223
Paper insulated	759,228	7,636,926	9,016,692
Rubber insulated	570,822	4,644,129	5,313,203
Thermoplastic insulated	167,837	838,890	1,436,326
Other	178,775	1,991,129	2,153,356
	2,692,053	22,160,519	29,438,727
Accumulators for motor vehicles	135,807	1,545,683	1,582,253
Ditto, traction	36,378	179,460	279,734
Ditto, radio and other portable	110,421	585,107	859,387
Ditto, other	53,421	326,293	668,044
Parts and accessories	143,320	944,096	961,246
Elec. porcelain, etc. (incl. insulators)	97,439	915,180	1,121,302
Insulating cloth and tape	54,675	616,119	618,290
Other insulating material	100,595	963,409	1,007,072
Permanent magnets	65,006	463,024	458,919
Radio, telegraph and telephone testing equipment, n.e.s.	32,631	383,804	424,878
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	14,382	256,132	146,986
Other	250,747	2,205,746	2,176,870
Electrical machinery, n.e.s.	78,455	1,051,085	1,129,914
Electrical apparatus and appliances, n.e.s.	873,360	6,157,035	7,768,767
TOTAL	19,164,166	156,979,464	180,978,874

TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	October, 1956	Ten months ended October, 1955	Ten months ended October, 1956
	£	£	£
Channel Islands	107,825	622,188	752,039
Gibraltar	14,565	161,461	382,773
Malta and Gozo	178,523	463,611	684,620
Cyprus	146,554	973,701	1,343,700
Sierra Leone	23,205	210,758	253,286
Gold Coast	143,088	1,519,901	1,391,632
Nigeria	303,757	2,596,652	2,847,958
Union of South Africa	1,235,767	14,867,488	12,920,156
Rhodesia and Nyasaland	504,517	4,424,510	5,004,953
Tanganyika	39,812	875,939	532,373
Kenya	236,658	1,702,433	2,357,626
Uganda	64,348	1,019,822	713,234
Anglo-Egyptian Sudan	47,772	773,749	725,026
Mauritius	31,202	296,469	227,330
Aden	53,657	422,217	464,987
Bahrain, Qatar and Trucial States	87,945	766,976	872,626
Kuwait	169,961	862,462	1,361,830
India	1,950,606	13,183,201	18,025,644
Pakistan	379,452	3,267,264	3,063,969
Singapore	352,129	3,132,041	3,079,837
Federation of Malaya	346,031	2,412,351	2,738,341
Ceylon	181,672	1,186,610	1,871,691
British North Borneo	21,833	196,917	237,824
Sarawak	13,062	159,092	152,814
Hong Kong	356,629	1,573,985	2,253,281
Australia	1,718,838	17,500,985	18,481,896
New Zealand	846,385	10,016,233	8,676,961
Fiji	26,469	187,295	215,003
Canada	1,375,189	6,807,479	10,947,998
Jamaica	75,844	857,403	973,385
Barbados	20,826	194,764	237,394
Trinidad	78,153	901,260	997,955
British Guiana	42,865	451,077	384,649
Other Commonwealth countries	97,485	1,134,507	903,009
Irish Republic	297,407	3,319,653	2,865,105
Soviet Union	102,844	2,676,107	2,173,973
Finland	183,173	1,313,180	1,508,897
Sweden	364,886	3,310,681	3,411,785
Norway	234,879	2,844,659	2,160,418
Iceland	19,392	123,784	145,441
Denmark	270,324	1,410,180	1,887,280
Poland	30,093	194,636	291,113
Western Germany	256,179	1,715,587	1,750,229
Netherlands	802,239	5,572,840	6,455,810
Belgium	356,713	2,355,771	2,871,892
France	527,508	2,637,552	3,578,116
Switzerland	114,987	879,298	995,919
Portugal	235,776	1,900,598	1,666,493
Spain	491,414	1,344,910	3,951,823
Italy	355,261	2,303,866	2,827,913
Austria	52,701	470,346	385,798
Yugoslavia	36,964	583,288	462,230
Greece	125,808	1,026,827	2,172,045
Turkey	38,311	957,678	693,179
Belgian Congo	46,718	254,324	286,728
French Morocco	68,060	303,205	437,140
Portuguese East Africa	32,931	198,607	222,648
Egypt	69,826	1,380,621	1,651,598
Libya	34,238	174,916	270,176
Syria	88,590	268,049	680,006
Lebanon	111,932	319,810	583,453
Israel	77,062	352,956	876,571
Jordan	22,147	329,715	517,583
Saudi Arabia	110,136	769,550	1,219,816
Iraq	239,976	1,981,693	2,952,931
Iran	158,157	662,373	1,796,023
Burma	100,179	1,548,884	1,129,591
Thailand	90,879	1,376,243	873,049
Indonesia	47,978	274,360	515,200
Japan	70,013	923,735	662,639
United States	669,445	4,335,674	7,662,832
Cuba	30,808	239,040	359,644
Mexico	39,289	376,378	714,062
Colombia	88,268	816,368	780,249
Venezuela	239,025	2,083,858	2,634,345
Peru	90,041	428,069	539,282
Chile	85,891	237,479	335,780
Brazil	62,549	642,367	1,524,305
Uruguay	14,355	339,580	101,412
Argentine Republic	84,163	1,444,252	787,980
Other foreign countries	222,027	2,253,116	2,530,572
TOTAL	19,164,166	156,979,464	180,978,874

with £279,605 and South Africa which bought equipment valued at £278,571.

France maintained its position as the principal purchaser of radio and electronic apparatus, taking goods valued at £304,991, the Netherlands holding second place with purchases of £248,487. The principal Commonwealth buyer was Australia which took goods valued at £227,467. Australia was again the best market for telegraph and telephone equipment, imports to that country totalling £293,524. South Africa, with purchases of £219,166 was second, while outside the Commonwealth countries Spain was the most important buyer with a value of £174,842. India was easily the best market for cables and wires, its imports totalling £524,866. The next best customer was New Zealand, which took supplies to the value of £197,431.



In addition to the electrical equipment and apparatus shown in Table I, the following apparatus is shown separately in the returns:—

Electrically operated washing machines, complete, not exceeding 150 lb net weight: October, £385,383; ten months, £2,967,945. Ditto, 150-250 lb net weight: October, £123,378; ten months, £1,037,882. Parts: October, £86,796; ten months, £695,037.

Electric lighting fittings and lanterns, complete, with or without bulbs (excluding arc lamps, searchlights and cycle lamps): October, £160,038; ten months, £1,444,230. All other electric lighting appliances: October, £335,435; ten months, £3,224,321.

Electric carbons, including parts: October, £64,370; ten months, £495,371.

Welding electrodes (excluding carbon), covered: October, £129,209; ten months, £1,120,654.

Electric conduit tubes and cased tubes: October, £86,523; ten months, £721,536.

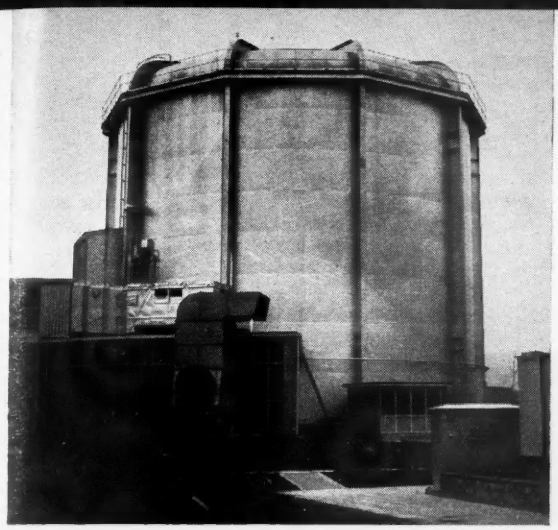
Electric locomotives: October, £360,654; ten months, £2,278,805. I.c. engine locomotives with electrical transmission: October, £711,868; ten months, £7,528,651.

The distribution of exports of the classes of electrical machinery and apparatus shown in Table I is indicated in Table II.

Electrical Imports

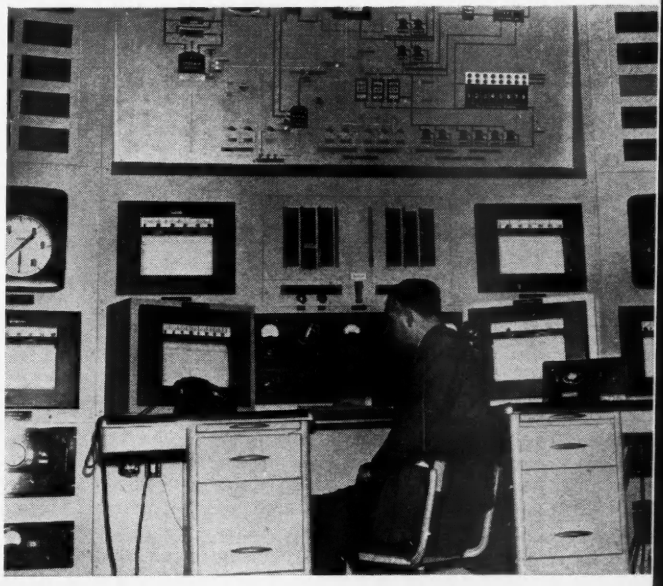
Imports of electrical equipment continued to rise, and in October the value was £2,224,590, as compared with £2,023,992 in September. The total for the first ten months of this year was £19·6 million (against £19·7 million in January-October, 1955). The two leading suppliers were again the United States (which shipped goods valued at £622,753) and Western Germany (which sent us equipment valued at £415,248). Third place was taken by the Netherlands with a total of £294,332. As for some time past, radio and electronic apparatus was the principal class of imports.

NEW RESEARCH REACTOR



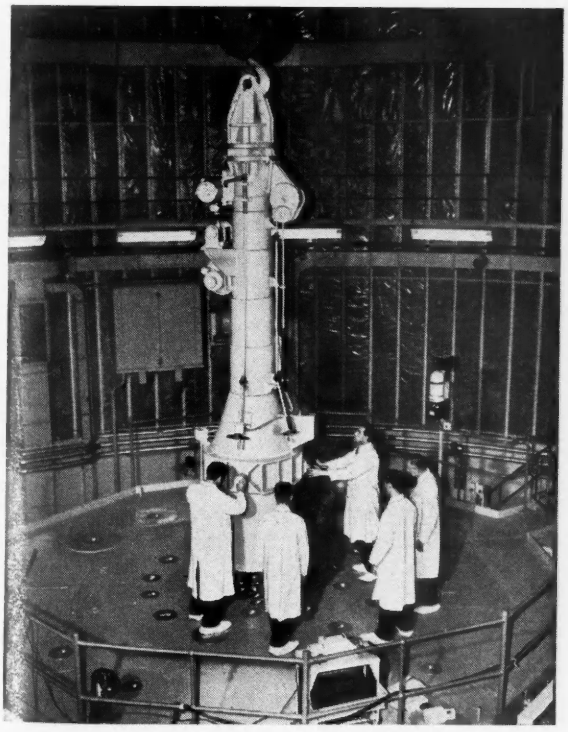
Official Inauguration of DIDO

ON 21st November the new research reactor DIDO, which has been constructed at the Atomic Energy Research Establishment, Harwell, was officially opened by Sir Cyril Hinshelwood, President of the Royal Society. DIDO is the most powerful reactor of its kind in Western Europe; it was built to provide the intense neutron fluxes which are now needed both to help advance the United Kingdom Atomic Energy Authority's reactor research programme and to serve as a fundamental research tool in the nuclear sciences. A reactor of the same design as DIDO is now being constructed at the Australian Atomic Energy Commission's research establishment at Lucas Heights, near Sydney.



View of the main control panel for operating DIDO

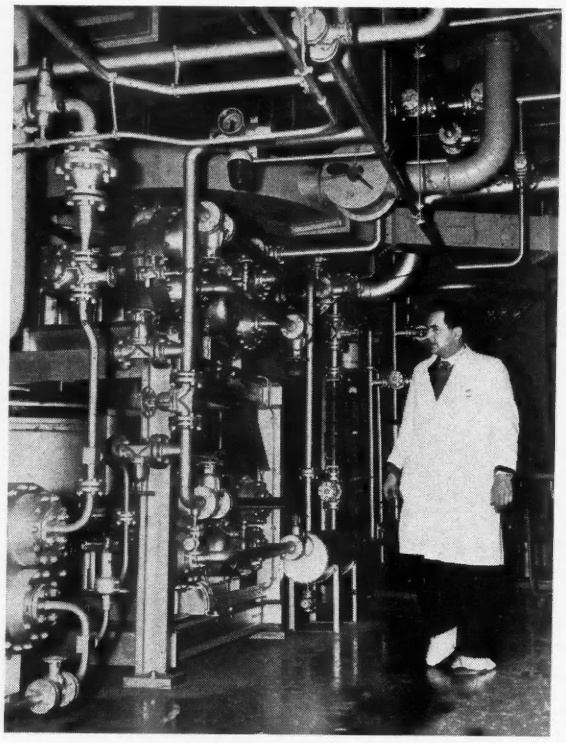
Technicians place into position the 12 ton loading and unloading flask



The new reactor at Harwell will be used to do a wide variety of experiments ranging from fundamental physics to basic technology; for example, a "time-of-flight" neutron spectrometer is being installed to study nuclear physics problems, and the effects of radiation on materials will be studied in the reactor with special reference to the alterations which are caused in possible power reactor coolants, moderators and fuel assemblies. It is hoped that the more fundamental scientific aspects of the work carried on at Harwell with this reactor will, in due course, be studied in association with university research workers.

DIDO is a heavy-water-cooled and moderated reactor which is fuelled by highly enriched uranium. The name given to the reactor was suggested by the chemical symbol D_2O, for the heavy water molecule. The core of the reactor is an array of twenty-five vertical boxes each made up into a composite fuel element from ten curved uranium-aluminium alloy plates; the array of boxes forms a rough cylinder about the size of a tea chest. The reactor is controlled by moving cadmium sheathed "signal arms" into the core between the fuel elements.

The circulating heavy water, which is forced upwards through the fuel element assembly for cooling, is contained in an aluminium tank surrounding the core. This core tank is in turn surrounded by a graphite reflector



A technician walks through the heavy-water control room of the DIDO reactor

sealed into a helium-filled steel tank and by the concrete biological shield. The heavy water is pumped through the core tank from a circuit outside the reactor; the heat generated by the system is transferred to a secondary coolant, ordinary water, in a heat exchanger in the heavy water circuit. The secondary coolant dissipates the generated heat to the atmosphere in cooling towers outside the reactor building. The whole of the reactor area is enclosed in an air-tight shell with controlled entrances so that any accidental spread of radioactivity can be readily confined.

Specially designed experimental holes have been built into the reactor to meet particular experimental requirements. In some of these holes it is possible, for example, to control sample irradiation times very precisely, or to permit the emergence of defined neutron beams. It is also possible to maintain two large-scale "engineering pile loops" in the reactor to test fuel assemblies for advanced power reactor designs; some holes are to be used to manufacture cobalt-60 at high activity levels for hospital and industrial use in quantities equivalent to about 30 kilograms of radium per annum. A large "active handling" bay has been built close to the main reactor building to provide means for the handling of highly radioactive samples or for the dismantling or modification of experimental equipment removed from the pile; experience with BEPO has shown that a powerful reactor can be more fully and economically utilised if provision is made for operations of this kind close to the reactor.

DIDO became critical for the first time in the early hours of 7th November. The fuel element which caused the reactor to become divergent was inserted into the reactor by Sir John Cockcroft. The reactor and its associated plant and buildings were designed and constructed by an Atomic Energy Research Establishment team, in association with the Ministry of Works and Head Wrightson Processes, Ltd. The Ministry of Works were responsible for the detailed design and co-ordination of the civil works and services in association with a number of industrial firms.

Another research reactor which has recently been completed at Harwell is known as LIDO. This is a "swimming pool" reactor which has been built primarily to carry out shielding experiments, one of its major tasks being to assist in the development of the British Submarine Propulsion Unit. The enriched-uranium plate-type fuel

THE HARWELL REACTORS

Name	Date of Start-up	Peak Neutron Flux	Maximum Heat Output	Moderator	Coolant	Fuel	Purpose
GLEEP	1947	10^{10} thermal n/cm²/sec	100 kW	Graphite	Air	Natural uranium metal and oxide	Initially isotope production and general neutron physics. Now routine graphite uranium quality testing, research with oscillator, biological irradiations.
BEPO	1948	$1{\cdot}5 \times 10^{12}$	6 MW	Graphite	Air	Natural uranium metal	Isotope production and general radiation source.
ZEPHYR	1954	8×10^{12} (fast)	a few watts	None	None	Plutonium	Fast reactor studies.
DIMPLE	1954	10^{8}	100 watts	Heavy water	None	Varies	Thermal reactor studies.
ZEUS	1955	5×10^{9} (fast)	100 watts	None	None	Uranium-235	To study a particular core design for Dounreay fast reactor.
ZETR	1955	4×10^{5}	negligible	Heavy or light water	None	Uranium-233, 235 or Plutonium	To study physics of homogeneous aqueous systems.
LIDO	1956	10^{12}	100 kW	Natural water	Natural water	Uranium-235	Thermal reactor studies, including shielding.
DIDO	1956	10^{14}	10 MW	Heavy water	Heavy water	Uranium-235	Isotope production, neutron physics, radiation chemistry, nuclear reactor material studies.
PLUTO	1957	10^{14}	10 MW	Heavy water	Heavy water	Uranium-235	Nuclear reactor material studies.

A second PLUTO type reactor is also due to start up at Dounreay in 1957.

elements (similar to the DIDO "box" elements) are suspended in a large concrete tank of purified water. The tank is 24ft deep by 8ft by 28ft and is surmounted by a movable trolley. Suspended from the trolley is a framework which supports the reactor core which is about the size of a tea chest. Shielding experiments are made by moving the core of the reactor close to aluminium windows which are set into the walls of the tank. The heat output is about 100 kW. The reactor became critical for the first time on 21st September, 1956. The detailed design and construction of the reactor was carried out by a joint naval and Atomic Energy Research Establishment team, in association with a number of industrial firms.

A further reactor known as PLUTO is also under construction at Harwell. Details of this and all of the other reactors at A.E.R.E. are given in the table on page 1014.

Calder Works Plant

Discussions at Last Week's Symposium

THE papers which were presented in the first two sessions of last week's symposium on the Calder Works nuclear power plant were summarised in our issue of 16th November. The discussion at the first session was opened by Sir George Nelson (English Electric Co.), who said that Calder Hall pointed the way to better things to come, with higher ratings and lower capital costs. In collaboration with the United Kingdom Atomic Energy Authority, designs for more advanced stations had already been worked out by groups of manufacturers employing their own teams of scientists and engineers and a further advance had been made in design.

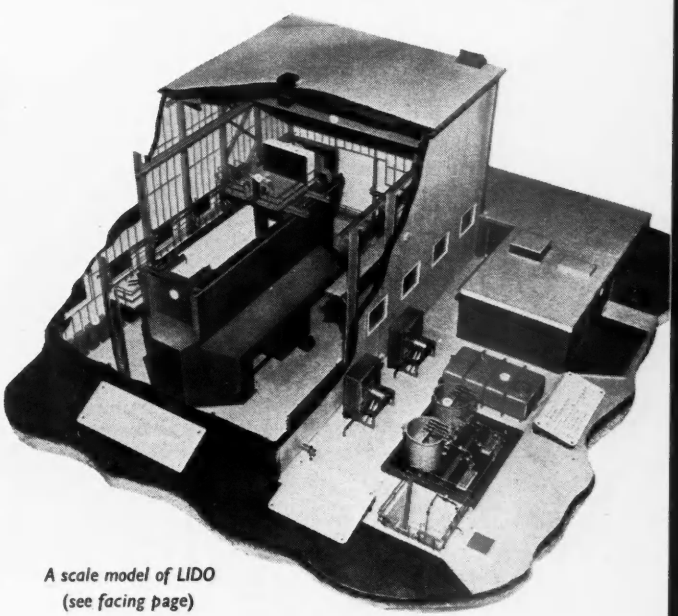
Mr. H. West (A.E.I.-John Thompson) said that the opening of DIDO at Harwell would provide excellent test facilities, but they would hardly be sufficient to meet the requirements of the U.K.A.E.A. and of industry. He understood that it was proposed to install a second materials testing reactor at Harwell and one at Dounreay, which should go a long way to meet the demand, but industry and the Authority should get together to decide upon a suitable programme for materials testing. However much industry would like to have its own materials testing facilities, this was unlikely in view of the cost.

Industry must look for an export market in nuclear energy. First, there were the areas not served or badly served with conventional fuels and which could utilise outputs of about 60 MW. Such nuclear power stations must be fully competitive with thermal stations, but in view of the scarcity of conventional fuels generation costs could reach 2d/kWh. This market would appear to be available now and would depend only on the release of suitable atomic fuel and the ability to meet the demand without interference with the home programme. Secondly, there was the possibility of using nuclear instead of fossil fuels in the normal course of overseas business. The average power unit installed abroad was less than 30 MW, so that reactor designers must produce a small station which would be economic. Enriched fuel would be required, which was scarce in Britain, and this problem must be solved if we were to maintain our pre-eminence in the export market.

Mr. A. L. G. Lindley (G.E.C.) emphasised that the larger the reactor the more favourable the cost of generation, so that the aim should be to have the largest pressure vessel which could be built with the materials and construction methods available. Such stations should be kept in continuous operation to obtain a good load factor and maintain continuity of supply, and it should be possible for charging and discharging and maintenance to be carried out while running. If by 1965 much greater reliance was to be placed on nuclear power, industry ought to be looking ahead now. The extent to which it could shoulder the burdens involved would depend on the encouragement it received and on a definite indication being given of the long- and short-term intentions regarding the future of nuclear power.

Sir Claude Gibb (C. A. Parsons) believed that the papers which had been presented pointed the way to a future energy policy for Britain which alone could reduce our dependence on imported oil. It must not be thought that British engineering was resting on the laurels gained for it by Sir Christopher Hinton and his colleagues. Designs were available to-day which, though based upon Calder Hall, made an advance in efficiency and cost which was extraordinary considering the short time which had elapsed since the Calder Hall design had been completed. Only the Government could decide the rate at which we exploited our present world lead in nuclear power. Natural uranium graphite-moderated gas-cooled reactors of proven design and proven economics were available to-day as the salvation of our industrial future, and there was no other type of reactor in the world which was so competitive or so safe.

Mr. F. H. S. Brown (C.E.A.) referred to the statement in the White Paper on nuclear power that it was expected



A scale model of LIDO
(see facing page)

that nuclear power would prove directly competitive with power generated by orthodox means and pointed out that if that were accepted as a target—and it was a target which they had every confidence would be achieved—it was worth noting that it was a moving target, since the development of orthodox stations was still proceeding at an appreciable speed. The heat exchanger at Calder Hall was an outdoor unit. The C.E.A. was operating a semi-outdoor boiler without trouble, but its success depended upon the precautions taken to avoid the freezing of small-bore pipelines. A characteristic of Calder Hall was the large extent of the external pipework, much of it of small bore.

Mr. G. F. Kennedy (Kennedy & Donkin) said that it had been stated that the life of the plant might be limited to 20 years and asked what would be the position of a reactor plant at the end of that period. Could it be relegated to lower load factor operation or would it have to be shut down completely?

Materials Testing Reactors

Mr. W. L. Owen, replying to the discussion, said it was the intention of the A.E.A. to build two bigger materials testing reactors, one at Harwell and one at Dounreay, and it was hoped that these would come into operation next year. Mr. West had referred to 30 MW reactors for export. The Authority was aware of this need and was doing something about it, but in the meantime Mr. Owen hoped that the Calder type of reactor would meet the demand in the early stages. It was true that the efficiency of conventional plants was going up, but that improvement could be more than offset by increases in the price of coal.

Mr. R. V. Moore, referring to the possibility of the freezing of the heat exchangers, pointed out that only a few zones of the reactor would have to be recharged at a time, so that the plant would be shut down only for a day or two, and during that time the reactor would still be generating heat from the decay of fission products. This heat would be circulated to the heat exchangers, and if it proved insufficient, steam could be introduced into the boiler drums from auxiliary steam supplies. The nuclear reactor should have a long life, because it was completely static and had nothing comparable to the impingement of combustion gases on the plant which occurred with coal-fired boilers.

Technical Research Problems

The discussion on the papers presented during Thursday afternoon was opened by Prof. O. A. Saunders (City and Guilds College), who referred to the paper on heat-transfer experiments by Fortescue and Hall and said that the fundamental advantage of longitudinal fins over cross fins for fuel element cans was that by keeping the flow parallel to the surface, wastage of pressure drop in generating ineffective turbulence at the edge of the fins was avoided; but in a reactor with a long flow path and large coolant temperature rise compared to the maximum temperature drop it was essential that non-uniformity of coolant temperatures should be avoided at all costs and cross fins were a better method of doing this.

Mr. R. D. Vaughan (Nuclear Power Plant Co.) said that it was significant that in the Calder reactor it was not necessary to make any reference to re-irradiation for purposes of optimisation, and in this it differed markedly from the larger industrial reactors of which it was regarded as the prototype. In the industrial design it was desirable to keep the fuel in the reactor as long as possible. This called for a reserve of reactivity to be built into the reactor. On the Calder basis of design such spare reactivity would be used to admit absorbers for flattening and in no other way, but in an industrial reactor it could also be used to give long re-irradiation of the fuel. It might be unwise, therefore, to make too many deductions from the Calder design in trying to work out generation costs for industrial type reactors.

Mr. P. R. J. French (A.E.I.-John Thompson), referring to the paper by Mummery, said that at present it was difficult for anyone outside the A.E.A. to make a positive contribution on the experimental physics of the subject. To set up an exponential experiment for a uranium graphite reactor would require large quantities of uranium and graphite of the highest quality, costing hundreds of thousands of pounds even if they could be obtained. The latest information, however, was freely made available by the Authority within a short time of the experiments being carried out, and industry had even been given a voice in the formulation of the experimental programme, within the limits set by the Authority's own urgent requirements. If the industrial development of atomic energy in this country was to flourish, it was probably essential for the industrial organisations themselves to carry on a research programme, and probably in the next year or two several research reactors would be operating outside the A.E.A.

Metallurgists' Achievements

Dr. H. M. Finniston (A.E.A.), discussing the papers by Huddle and Wyatt and by Grainger and McIntosh, recalled Sir Christopher Hinton's dictum that the art of the engineer was to make use of available scientific knowledge of materials and techniques and said that nuclear engineers practised this art by making two demands on the metallurgist: one was to achieve the ideal and the other was to achieve the impossible, and generally to a time scale. The authors were to be congratulated on achieving the near-impossible, and to a large extent the success of Calder Hall stemmed from their work.

Dr. E. Emley (Magnesium Elektron) said that although his firm was used to impressing on potential customers that there was virtually no fire risk with magnesium, when Mr. Huddle first talked to them about the use of magnesium alloys in reactors they had been a little scandalised, and were not easily talked into accepting the contract. The alloys appeared to have very satisfactory resistance to oxidation, and the interesting result had been found that if one increased the flow rate of the CO_2 gas one apparently raised the ignition temperature, which was a useful safeguard.

Mr. R. A. Skinner (A.E.I.-John Thompson) referred to the fact that the paper by Grainger and McIntosh showed the necessity for carrying out research and supplying answers to design and production problems to a time scale which was rigidly fixed. This outlook was not general, but the authors had shown that it could result in research work of very high calibre. Several other contributions were made to the discussion, mainly on metallurgical details, and the authors briefly replied.

Engineering Design

At the third session, Engineering Design, on Friday morning, Sir Claude Gibb, C.B.E., D.Sc., F.R.S., chairman and managing director of C. A. Parsons & Co., Ltd., and president of the Nuclear Power Plant Co., Ltd., introduced Papers Nos. 10, 11 and 12—"Design and Construction of Reactor Vessel," by G. Brown, M. J. Noone and R. F. Bishop; "Uranium Fuel Handling," by K. H. Dent and G. W. Grossmith; "Design of Important Plant Items," by A. T. Bowden and G. H. Martin.

Mr. R. H. Miller (G.E.C.-Simon-Carves Atomic Energy Group) opening the discussion, said that forgemasters

were unwilling to supply forgings with guaranteed impact values, and that could lead to the designer being forced to use forgings of lower notch ductility than that desirable in the plates and the shell of a pressure vessel.

The fuel handling equipment allowed the designer great scope for ingenuity, but that had to be tempered by the need for reliability and ease of maintenance. He considered it possible that the problem of mechanical design had been exchanged for the even more difficult one of shielding and the prevention of radioactive contamination. There appeared to be a serious contamination risk to operators during the removal of the blank flanges and the handling of the charge chutes, and it was possible that the whole of the charge floor might in time become contaminated.

Friction Joints

Dr. H. S. Arms (English Electric Co., Ltd.) said that what particularly impressed him about the papers was that everything was made to look so simple. One would have thought that the use of friction joints at a number of points in the reactor would have been intolerable, but it was obvious from what had been said and from the operations at Calder Hall that in most cases the design had been so cleverly arranged that the movement encountered was acceptable in spite of the fact that one might question the principle which was used in designing the joints.

Mr. D. A. Pask (U.K.A.E.A., attached to Calder Hall from C.E.A.) said that in a plant like Calder Hall it was extremely necessary to design a very flexible duct-work system. He felt that very great thought had to be given to the simplification of the duct-work system. Butt welded joints would give a far easier system of welding and far better joins when finished. Valves should be eliminated wherever possible. The standard of valves was high, but, under the conditions required, not high enough. There was always leakage from glands and across faces, even though there was the necessary tightness to begin with. It was intolerable that an industrial reactor should have a large leakage rate. He was convinced that it could only be eliminated by cutting down the flexibility of the gas ducts and the ancillary systems a very great deal.

Welding of Pressure Vessel

Mr. C. C. Bates (Society of Non-Destructive Examination) said he appreciated that in producing such a unique structure as the Calder Hall reactor pressure vessel no expense would be spared in establishing that all the site welds were as sound and free from defects as was practically and economically possible, because a future failure, perhaps propagated from micro-cracking, could produce disastrous results. In view of the known limitations of X-radiography in revealing cracks and the now known reliability of ultrasonic examination, he wondered why only X-radiography was used on the butt welds. With such a type of vessel, he suggested that there was a case for using both types of equipment complementary to one another.

Prof. E. F. Boon (Technical University, Delft) said he was glad that the authors had not said that their designs were inherently safe, for the knowledge of engineers had not yet advanced sufficiently far for them to be able to say that they could design equipment which was inherently safe.

He asked why the authors had not given the vessel a hemispherical top and bottom, for it would then not have required the forgings or 4½in plate, which was at present necessary for reinforcement. Thick plate and forgings had a greater tendency to brittle fracture than the thinner plate, 2in thick, used elsewhere in the construction.

Mr. J. Noone, replying to the discussion, said that more was known about the radiographic technique than the ultrasonic method, and also the results could be stored. They had decided to use radiography because they could do it better, but ultrasonic testing was used for the plates.

The use of a hemisphere would not have dispensed with the need for 4½in plate, which was on the cylindrical portion of the vessel. The hemispherical type was not as good as the ellipsoidal type, economically.

Mr. Dent, replying to the discussion, said that to open and close the flanges of the charge tubes remotely would cut across the basic philosophy of reliability of charging plant.

Recharging on load was considered in the early days, but even 3½ years ago the problems of recharging were not as clearly understood as they were now. Because the economy of recharging on load was uncertain, it had been decided not to jeopardise the operation of the prototype plant or its possibility of being built by introducing complications of that sort.

Dr. A. T. Bowden, who also replied, said that reference had been made to the difficulty of maintaining tightness in the duct system. Flanged joints had been introduced where components were considered vulnerable or expendable, such as valves and bellows. It was thought at the time that removal would be easier if that system were adopted, but in the light of experience at Calder Hall he thought that if the components had been butt welded into the system removal and replacement would have been little, if any, more difficult.

Steam Cycle

Following the introduction by Mr. T. B. Webb of papers Nos. 13 and 14—"Steam-Cycle Analysis," by W. R. Wootton; "Design and Construction of Heat Exchangers," by H. Morris and W. R. Wootton—Mr. J. H. N. Thompson (John Thompson, Ltd.), opened the discussion, saying that the setting up on the site of facilities for practically the whole series of operations in the manufacture of a large pressure vessel—all except the plate forming—meant a great deal of new planning for the boilermaker because all the operations had previously been done in the works. In view of the considerably changed conditions and problems, future boilermaking in the works would take on a quite different look. The changes would be appreciated when it was realised that a pressure vessel for a conventional station required 160 tons of steel but one for a nuclear plant required 5,000-6,000 tons.

Mr. F. Shakeshaft, O.B.E. (mechanical engineering consultant, C.E.A.) said that selection of a dual pressure regenerative feed heating steam cycle was based on sound thermodynamic and engineering production considerations, so as to ensure an optimum degree of available energy utilisation from the steam cycle when using simple plant components of reasonable manufacturing cost. The question of meeting an ever-increasing electricity demand with a static production of coal in this country focused attention on the need for the rapid development of large, efficient and reliable atomic power generating stations.

Regardless of the type of reactor employed, if the coolant outlet temperature were made available in the neighbourhood of 500-550 deg C, steam power plant could at once be constructed to operate on higher pressure steam cycles than in any British coal-fired power station at present on order.

The incentive was high, as within a decade atomic power stations could conserve some 40 million tons of

coal per annum, which by that time would represent a monetary value of at least £200 million per annum, or £1,000 million in less than five years, having due regard to the rapid increase in power demand. In those circumstances, liberal funds ought to be set aside to cover such important fundamental research.

Mr. D. R. Berridge (C.E.A.) said that the work of Mr. Wootton and his colleagues on the dual pressure steam cycle represented an outstanding contribution to the problem of utilising effectively the heat in the coolant gas leaving the reactor for the purpose of power generation. Subsequent stations would depend upon the dual pressure steam cycle for attaining the performances claimed for them. The dual pressure steam cycle really established itself when it showed that it could be adopted most readily to meet the special requirements of Calder Hall. But for that, the Calder Hall heat exchangers might to-day have waste coolers in them.

M. Jean Picard (Paris) suggested that on the grounds of cost and performance it was desirable to reduce the terminal temperature of the high pressure superheater and increase that of the low pressure superheater.

Mr. E. Anderson (Nuclear Power Plant, Ltd.) said that Mr. Wootton and his colleagues were to be congratulated on the design of the heat exchangers. They were approached in 1948 with a sheet of data, and a few months later they had produced something which looked very like the present design, and it had formed the corner stone on which the plant had been built. He considered that the ratio 77:23 of high to low pressure steam had been justified in practice.

Mr. W. Wootton, replying to the discussion, said that there were good grounds for suggesting that steam would be in the forefront of nuclear power generation for a long time to come, and certainly in the foreseeable future.

Mr. H. Morris, replying to the discussion, said that it could be stated with confidence from the test data already obtained that the heat transfer figures were coming out very near to what had been predicted, and they were very happy about the situation.

Control Equipment

At the Friday afternoon session Dr. D. Taylor (Director, Electronics Group, U.K.A.E.A., A.E.R.E., Harwell) introduced the four papers Nos. 15, 16, 17 and 18—"Equipment for Control of the Reactor," by S. A. Ghalib and J. H. Bowen; "Detection of Faulty Fuel Elements," by E. Long, J. M. Laithwaite and K. V. Cunningham; "Reactor Control and Instrumentation," by R. J. Cox and K. R. Sandiford; and "System Control and Protection," by E. Anderson and J. H. Bowen.

Mr. R. S. Medlock (George Kent, Ltd.), who opened the discussion, said it was a matter for congratulation that great thought and care had been devoted to designing the instrumentation scheme at Calder Hall at an early stage. A great deal of the instrumentation was conventional but there was some which presented particular problems. Burst slug detection had been an awkward problem for years, but the authors had pursued its solution to a successful conclusion. Mass flow presented another problem and although the solution was admirable from the design point of view it was bad operationally because four flows had to be summated to arrive at the total. This affected accuracy to some extent.

Mr. S. T. Shepherd (C.E.A.) suggested that the segregation of the functions of steam production and steam utilisation was quite wrong. It would be more logical to place the controls for both reactors in one control room, although they should be quite separate. The electrical output could be controlled from the same control room. Each reactor could be controlled by a technician with overall control by a shift engineer. The control room engineer would have a complete picture of the power station and know exactly what was going on in the plant. He would also have a primary place to which to proceed in an emergency, from where he could make major decisions and see that they were implemented. The disadvantage lay in the possible difficulty of accommodating the numerous instruments in a reasonable space and avoiding strain upon the operators. No doubt in the future fewer instruments would be needed, but that time was not yet.

Mr. K. L. Stretch (U.K.A.E.A.) said that the control and instrumentation side was that which had given most satisfaction. Although other aspects might decide whether the reactor could operate easily or efficiently, without this side it could not be operated at all. He approved having as much instrumentation as possible, but he thought the operating staff might be more ruthless than the designers in throwing out instruments of whose reliability and usefulness they were not satisfied. While certain criteria were necessary as operating standards in the early design stages, they were not always the ones adopted by the operator. If instruments were left, their maintenance tended to be neglected and they might not be reliable when they were wanted.

Detection System

Mr. A. L. Shaw (A.E.I.-John Thompson Nuclear Energy, Ltd.) said that great credit was due to the authors and their associates for designing the burst slug detection system described in paper No. 16. The authors had avoided any system of channel scanning involving moving parts within the reactor pressure vessel, but unfortunately this involved some forty miles of small bore pipes. Perhaps for future reactors mechanical scanning units, fully retractable for maintenance purposes, could be devised.

Mr. John R. Huffman (Philips Petroleum) said that the detection of leaks in fuel assemblies was a worrying problem. The technique developed at Calder Hall was interesting, but he doubted whether it went far enough. In the United States a gamma scintillation technique had been developed for a materials testing reactor.

Mr. A. Merton (G.E.C.) said with regard to paper No. 15 that he was not surprised that the effect of the increase of the rod diameter produced little effect on percentage k (Fig. 2), but he did not see why the curve for the two diameters shown tended to become steeper.

Failure of Diagrid

Mr. Woodhall (Ministry of Works) said the papers covered nearly every eventuality, operational or otherwise, except collapse of the diagrid. He believed that all previous graphite-moderated reactors in this country had had the core set on a fairly substantial slab and probably the worst that could happen would be some deformation of the core. A failure of the diagrid might result in the core running away from the control rods and the result might be a rapid rise in temperature and pressure in the vessel which could be of explosive force.

Mr. F. Harlan (Dowty Nucleonics), referring to paper No. 16, said the authors had shown the importance of making the transit time of the gases through the precipitation chamber as long as practicable. At the same time, the radioactive particles had to be deposited on as short a length of wire as possible. These two factors taken together militated against efficient precipitation.

Mr. J. Ricard (Société des Forges et Ateliers du Creusot) said he understood that to increase the electrical load the blowers must be increased or the control rods

lifted or both. He asked which action was operated first and whether both were normally required.

Mr. T. Jarvis asked whether, in view of the alpha particles and the helium gas produced by the reaction with boron, the authors had any information which led to the conclusion in paper No. 15 that a 20-year life was possible for the control rods. Secondly, it was common practice in the United States to use a containment vessel even on inherently safe reactors. Why was this not considered necessary at Calder Hall?

Mr. D. A. Pask (C.E.A.) said he realised that in the early stages of start-up it was necessary to know the "feel" of the reactor and the control system, and to determine its response in varying conditions. But it would be interesting to know what consideration had been given to providing an automatic system for the regulation of the reactor power.

Mr. French (A.E.I.) referred to the method of measuring the reactor power described by Cox and Sandiford and suggested that considerable difficulty was involved. It depended on the volume average value of the thermal neutron flux throughout the core, and the value of the volume average inside the core depended on the manner in which the core flux was distributed. This was subject to considerable variation. A further difficulty was that the indication of the ionisation chamber depended amongst other things on the energy of the thermal neutrons inside the thermal column and the fission rate in the reactor on the average of the thermal neutrons in the core.

Future Developments

In presenting his paper "Development of Gas-cooled Reactors for Power Production" at the last session, No. 5, on Friday evening, Mr. R. V. Moore, G.C., B.Sc.(Eng.), M.I.Mech.E., M.I.E.E., added that technical and general design must proceed in parallel for the outcome to be satisfactory. Examination of the factors contributing to the cost per kWh of electricity indicated that the two design factors most important in reducing this figure were, first, a low capital cost per installed kW and, secondly, the removal of a large number of MW-days of heat from each ton of uranium.

Having considered the performance of reactors cooled with carbon dioxide, he said that among the other possibilities hydrogen had the best heat transfer properties of any gas. If the problems associated with its chemical activity could be solved, it would produce substantial improvements in performance.

Mr. P. T. Fletcher (Atomic Energy Authority) said that the Calder plant was capable of improvement by straight engineering treatment and did not depend for its next stage on extensive development work. In any reactor system, the pressure vessel was one of its first lines of defence. A sound pressure vessel formed part of the chain of safety precautions, and vigilance throughout its construction was of paramount importance.

Monsieur de Laage (French Atomic Energy Commission) spoke of Britain's brilliant achievement with the Calder Hall reactors. France had decided to base its first atomic industrial programme on the same type of reactor. The G1 reactor at Marcoule, in operation since the beginning of the year, was an open-circuit, atmospheric pressure type, air-cooled reactor, designed for plutonium production; it produced electricity, but only on an experimental scale. The twin reactors G2 and G3 being built at Marcoule, of the same type as the Calder Hall units, were dual-purpose reactors to produce plutonium and electricity.

Dr. Dunworth (Atomic Energy Authority) said that many at Harwell did not agree with the idea prevalent during the last ten years that in order to be economic, reactors must have such high ratings that liquid coolants were essential.

When an enriched fuel was used, it was possible to consider a much more intimate association of fuel and moderator than was possible in the Calder Hall reactor as it was now known. Such a scheme enabled much higher heat ratings and temperatures to be obtained than with present gas-cooled systems.

Gas-Cooled Reactors

Professor J. M. Kay said it could reasonably be claimed that the gas-cooled graphite moderated reactor was the only one available as a proved design for power generation on a large scale. He thought that it would remain the only commercial proposition for large base load power stations for many years to come. Gas-cooled reactors having heat outputs of the order of 500-600 MW and electrical outputs of the order of 150 MW were immediately practicable and economic without being dependent on the development of entirely new alloys or materials.

Mr. H. G. Davey (Atomic Energy Authority), comparing the first reactor at Calder with the first reactor at Windscale, said it could be seen to what extent the gap between theory and practice had been narrowed.

Mr. H. de Bruijn (Netherlands Reactor Centre) suggested that such was the rate of advancement that it seemed wise to calculate the economic life of a station like Calder Hall at about five years.

Mr. J. E. Field (C.E.A.) said he was absolutely convinced of the rightness of the gas-cooled reactor for land power purposes.

Dr. J. R. Menke (Nuclear Development Corporation of America) said it was natural and healthy that other countries were seeking different solutions, but the work that he and his colleagues had seen in Britain had won their great respect. The large civil engineering problems that had been solved, the very high temperatures being squeezed out of magnesium and the scrupulous attention paid to neutron economy, giving success with natural uranium, deserved congratulation.

Mr. D. W. Ginns expressed his faith in the gas-cooled reactors. It was important that technical effort should not be put into any project unless there was clearly a logical line of development of the type into more advanced reactors from the first conception. In leading the world in nuclear power production, Britain did not want its other industries robbed of vital technical man-power.

He paid special tribute to the late Sir Wallace Akers, who throughout the early days never lost sight of the ultimate objective of using nuclear fission as a source of power.

Mr. J. H. Bowen (C. A. Parsons) acknowledged the great debt owed by industry to both the U.K.A.E.A. and the C.E.A. and particularly those groups who had been selected to prepare the designs for the new C.E.A. stations. No better tribute could be paid to the work, skill, courage and achievement of the U.K.A.E.A. than by making certain that the fruits of the work would grow and flourish and that nothing a grateful country could do would be left undone.

Sir John Cockcroft, the symposium chairman, in closing the conference, said the discussion had shown the great importance of having early experience in building and operating a large-scale nuclear power station. The engineers were optimistic about future prospects, but great emphasis must be laid on the technological developments which had to go along with design, and continuing close co-operation between industry, the electricity authorities and the U.K.A.E.A. was called for.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

OF the many groups of problems associated with present-day transformer design, probably the last requiring final and complete solution is that of the surge strength of insulation and construction enabling the transformer to withstand the enormous electrical and mechanical stresses set up by surges of atmospheric and other origin. Countless experimental and theoretical investigations have clarified most aspects of these problems, but the fact remains that the designer of the largest units is still unable to predict exactly, for instance, the voltage distribution in the windings of the transformer at the drawing-board stage of the design, since he cannot calculate them in a useful approximation.

The author evolves all the essentials of the problems implied in a lucid and fairly straightforward way, showing the extent to which equivalent circuits, on which analytical methods are based, can provide useful information and where they must fail to lead to the required solution. He also outlines the important principles of non-resonant transformer design and effects of non-magnetic and magnetic static shields. The main feature of the paper is a demonstration of the necessity of using modelling methods and comparison of the three types of models, i.e. geometrical, " equivalent circuit " models, and electromagnetic models. The theoretical proof that only the last of these can ever be, and actually is, fully satisfactory, is borne out by the example of a 23·333 MVA, 220 kV transformer of which test results are compared with those obtained on the model. The striking coincidence is indeed one more confirmation that it is now unlikely that a better method can, or need, ever be found.—" Transformers, Surges and Models," B. Cerretelli, *Elettrotecnica*, Vol. 43, No. 8, pp. 394-410, 10th-25th August, 1956, in Italian.

Theory of Current Commutation

Considering the real conditions in circuits embodying intermittent sliding contacts, the form of commutation process to be aimed at should be characterised by the fact that the commutation period proper is considerably shorter than the period of the patent short-circuit and must be initiated and terminated by stages during which the current in the leading and trailing commutator bars is small. Calculations of the duration of the commutation period proper are conveniently based on the assumption of a constant contact (brush) drop, which is much more realistic than the assumption of a constant contact resistance. The commutating properties of the brushes are indicated by the extent to which the brush can maintain spark-free commutation in the unsteady-contact zones at the brush edges. These properties improve with increasing value of the voltage drop which the brush can withstand at vanishing current density in the transition layer, and with the ability of the brush to maintain this characteristic against rising commutator temperature.—" Problems of the Modern Theory of Current Commutation in Commutator Machines," O. G. Vegner, *Elektrichestvo*, No. 7, pp. 19-23, 1956, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Transformer Heat Dissipation

The lost heat of transformers is dissipated in two stages, viz. by transfer from the coils of the winding to the liquid insulant, generally oil, and from this to the cooling medium proper which may be the ambient air or water. Since the winding insulation is the part of the transformer under the highest thermal stress, and most sensitive to it, the rapid transfer of the heat from the winding to the oil is of overriding importance. It can be improved in two ways: by enlarging the effective cooling surface, and by increasing the flow velocity of the liquid coolant, since the effective removal of comparatively large quantities of heat has to rely on convection (particularly on account of the low thermal conductivity of oil).

It is easy to see that the advantage obtained in this respect by the usual pancake coils is not considerable because the oil circulation follows in the main the vertical ducts along the relatively small edge-areas of the coils and penetration into the horizontal ducts along the large circular coil areas is not sufficiently deep. A considerable improvement is obtainable in this respect by giving the whole coil the shape of a flat conical sheet, because the thermal convection flow is then forced up along the moderately sloping ducts, so investing the whole large coil surface. This is confirmed by theoretical considerations as well as experimental results. The sloping angle need not be larger than 4-6 deg to improve the heat transfer by 30-50 per cent.—" Transformers with Windings Consisting of Conical Pancake Coils," W. Häfner, *E.u.M.*, Vol. 73, No. 14, pp. 359-360, 15th July, 1956, in German.

Letter to the Editor

Letters should bear the writers' names and addresses not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Heater Control

I WAS very interested in your survey of low-temperature heaters in the issue dated 2nd November, but would draw your attention to a misleading statement in the introduction. I refer to the end of the second paragraph which states:—". . . are thermostatically controlled, ensuring an even level of temperature as well as economical use of electricity."

This statement is only true when the heater is in fact thermostatically controlled, but a number of manufacturers so describe their equipment when it is fitted with an energy regulator, which is virtually unaffected by air temperature. There are arguments in favour of each type, but it is incorrect to say that an energy regulator maintains an even level of temperature, and its only claim to economy is the ability to set it to suit individual conditions.

I have taken this question up with two manufacturers who have advised me that their equipment described as thermostatically controlled is in fact provided with an energy regulator only. In my opinion, this is a misleading description but would hesitate to describe it as deliberate.

Your error suggests that the loose use of the term " thermostat " is very widespread, and I feel that representations should be made to manufacturers to revert to truth in advertising.

Newport, Mon. R. G. MARTIN.

E.P.E.A. DINNER

THE toast of "The Association" was proposed by the Minister of Fuel and Power, Mr. Aubrey Jones, at the 29th annual dinner of the Electrical Power Engineers' Association, which was held on 23rd November. The Minister declined to discuss the present oil situation except for a reference to the co-operative spirit shown by the Central Electricity Authority in decreasing its demand for this fuel, which had greatly helped in lessening the amount of the cuts in supplies to other industries.

The doubling of consumption of electricity within the past ten years had made the supply industry one of the fastest growing in Great Britain. About half the population loved it, but the other half seemed to loathe it, to judge by disputes over power station sites and wayleaves. He wished the two halves could come together and not leave their differences for him to settle. In this country there was more tolerance to "objections" than in any other. He attached importance to outside investigations, such as that by the Herbert Committee with whose broad principles he agreed. Engineers, he believed, should have opportunities to rise to membership of the Electricity Boards to balance administrators and accountants.

Mr. J. E. Stanton (president, E.P.E.A.), responding, said that while the Association was a registered trade union, it was not tied down by any traditions that would obstruct the progress of the industry. Its regulations stated its primary purpose of promoting the industry's general advancement by raising and maintaining its efficiency and status. Its 16,000 members had no time to look back; they were concerned with the present and the future, thus increasing their value to their employers. They had played a major part in achieving operational efficiency through the use of higher temperatures and voltages and had the advantage of being in direct contact with the public.

Although the commissioning of Calder Hall and the projected building of the C.E.A. nuclear stations put this country in the forefront of this development and would fill the breach caused by deficiency of other fuels, he prophesied that steam would not be replaced within the lifetime of the youngest person present. While the Association was not too keen on new legislation or outside reports, it would loyally accept and work to decisions of the Government. The Association, however, reserved the right of criticism and hoped that its advice would be called for, as it had been in regard to previous reports. In welcoming the presence of Mr. Aubrey Jones, Mr. Stanton stated that every Minister of Fuel and Power had attended the E.P.E.A. annual dinners since the war.

The second toast, that of "The Electricity Supply Industry," was proposed by Col. B. H. Leeson (director, British Electrical and Allied Manufacturers' Association) who, speaking from 45 years' association with that

1. *The Minister of Fuel and Power and Mrs. Aubrey Jones; the President and Mrs. J. E. Stanton.*
2. *Mr. and Mrs. J. D. Peattie and Mr. and Mrs. A. E. Hawkins.*
3. *Mr. W. Arthur Jones and Miss Jones; Mr. and Mrs. H. Norton.*
4. *Mr. D. B. Irvine, Mr. and Mrs. H. V. Pugh, Mr. Norman Elliott.*
5. *Col. and Mrs. B. H. Leeson and Mr. and Mrs. W. N. C. Clinch.*
6. *Mr. R. Johnson, Mr. and Mrs. C. Donnellan, Mr. C. J. McMahon, Mrs. P. S. Watson, Mr. L. Benallick.*

industry, took as his text " electricity as a national asset," in which better living conditions were included. Old ways, he said, must go with the dodo and progress must come with the DIDO (the new heavy-water reactor at Harwell).

The restriction of capital expenditure imposed on the industry would hold up development and the position ought to be restored next year with an addition for the back-log, especially in view of the requirements of the Clean Air Act. The close liaison that existed between the electricity supply and manufacturing organisations was very helpful in fostering overseas trade. Plant installed in British power stations was of great interest to foreign visitors.

Response was made by Mr. Norman Elliott (chairman, South Eastern Electricity Board), who wondered what electricity people bought " one half so precious as the stuff they sell " and suggested that too many of them (unlike Mrs. Aubrey Jones) did not use electricity for cooking. He deprecated the view that man had become a cog in a machine. The president then paid the now customary tribute to the one-man dinner organising committee, Mr. F. H. Smethurst, in this case as regards the 25th function he had arranged.

Providing Engineers

AT a joint regional meeting of the Institutions of Electrical and Mechanical Engineers at Cambridge on 20th November (Mr. J. A. Sumner in the chair) the problem was discussed of securing enough engineers of the right quality to meet the future needs of industry. In an opening address Professor E. B. Moullin criticised Government Departments for their tendency to make too lavish demands on the available supply of engineers having high qualifications. If their claims were reduced, he submitted, the problem would be substantially less, as such men could be more usefully engaged on production work. This position arose largely as a result of Government control of industry during the war, when lay administrators required the services of an undue number of engineers. This policy had to some extent percolated through even to free industry, so that a larger technical personnel was needed to-day than 25 years ago for any given object. Moreover, the Government was able to offer graduates complete exemption from national service.

The need for trained engineers was greater than there was any likelihood of meeting; the main difficulty lay in securing young people to be trained. A new store of technical people must be sought, possibly including women, failing which the next ten years were going to be extremely difficult in regard both to maintenance of living standards at home and to the country's export trade.

Mr. James Wooding pointed out a " dichotomy " in the term " technical education," since the first word meant doing something in the same way everywhere, whereas the second related to the drawing out of individual characteristics. Engineering was a whole-time job and any broader cultural activity could be undertaken only in time stolen from engineering.

At Cambridge University courses were designed to produce " full men," and there was no desire for Great Britain to become a nation of technicians, but its inhabitants had to live in competition with other countries and so the aim of the universities had to be something more like seven-eighths full men. Employers, however, would be satisfied with five-eights for many jobs, for which G.C.E. or H.N.C. standards with extra English, mathematical and mechanical knowledge would be suitable.

Training at technical colleges must be designed for a purpose and fluid enough to permit of adaptation to local engineering industries, but adequate co-operation between colleges and industry was usually lacking. Too few entrants went in for design. Ability to use knowledge and not only to acquire it was an essential factor. Little more than 15 per cent of the population was inherently capable of thinking in abstract terms.

A defect of technical colleges was that the principals were responsible to various outside bodies. In this they compared unfavourably with the old public schools in which a headmaster was left to devise his curriculum free from interference. Dictated notes in class required no thinking and so left no abiding impression. Students should make only rough notes which they could work up and express in their own language. Sandwich courses should be on university lines, but at a somewhat lower level. They should carry exemption from national service.

Professor Baxter drew attention to the need to decide whether training was required to produce engineers all of the first rank or a relatively few to direct numbers having lesser attainments. In advocating small instruction classes, he mentioned that in some foreign countries the number in a class might run into hundreds. There were not enough good teachers, but industrialists might help by seconding suitable men.

He considered that universities were producing better engineers for the future than were technical colleges. The universities gave more attention to the fundamentals of education, whereas the technical colleges were apt to concentrate on the passing of examinations.

In the subsequent open discussion the following points were raised in addition to those presented by the principal speakers. It was said that the number of boys leaving school at 16 years of age at G.C.E. level was unsatisfactory. The Institutions should hold lower-level examinations for technicians. A job evaluation technique was required, giving more work to technicians, supervisors and foremen and preventing waste of engineering talent in administrative duties.

The limitations of lay administrators were pointed out. The work of engineers was not all technical and inevitably included much of an administrative character which made those of the right type suitable to hold the highest positions. Instruction in administrative principles might be added to the curriculum. While youths who were natural scientists or engineers were readily recruited, the bulk of those required would have to be obtained from men with no particular leaning that way. Some instruction should be given in æsthetic principles so that apparatus, especially for abroad, should have a good appearance. The Board of Education might be asked to supply standard sets of lectures and diagrams as an aid to teachers with inadequate experience and qualifications.

The low status of engineers in comparison with other professions was a hindrance to recruiting; this arose out of ignorance on the part of the public concerning their qualifications. Attention was drawn to the leading article in the *I.E.E. Journal* for November regarding the desirability of a more frequent use of the term " chartered " as likely to appeal to parents and headmasters.

PROGRESS OF WESTERN GERMANY

Increased Production and Exports

WESTERN GERMANY'S share of world electrical exports increased steadily from 12·6 per cent in 1953 to 18·1 per cent last year. The value of these exports rose in the same period from £105·3 to £175·4 million or by 67 per cent. In the first half of this year exports were valued at £99·3 million (against £79·4 million in January-June, 1955) and imports at £9·8 million (against £8·3 million). The trade is analysed in Table 1 which shows the growing importance of electronic equipment. While Western Germany's exports during the first half of 1956 increased by 24 per cent compared with the corresponding period of last year, her electrical imports rose by 19 per cent.

TABLE 1.—WEST GERMAN ELECTRICAL TRADE BY PRODUCT GROUPS

Product Groups	Exports		Imports		Percentage of Total Exports		Percentage of Total Imports	
	First half		First half		First half		First half	
	1955 (£m)	1956 (£m)	1955 (£m)	1956 (£m)	1955	1956	1955	1956
Electricity production and distribution equipment	31·2	37·0	2·2	3·2	38·9	37·1	26·9	30·8
Telecommunication, acoustic and measuring apparatus	25·1	34·0	3·4	3·7	30·4	33·3	41·9	37·4
Domestic appliances	9·0	11·3	1·1	1·0	10·9	11·0	12·5	11·1
Other equipment and apparatus	14·1	17·0	1·6	1·9	19·8	18·6	18·7	20·7
Total	79·4	99·3	8·3	9·8	100	100	100	100

In the distribution material section, switchgear and starting and regulating equipment show the biggest increases. Radio and TV equipment and components account for the increase in the electronic section. The geographical distribution of exports (Table 2) shows the traditional pattern, with Europe in the lead, while exports to Africa, though increasing in value, fell in relation to total West German electrical exports.

TABLE 2.—PERCENTAGE SHARES OF WESTERN GERMANY'S PRINCIPAL CUSTOMERS

Country	First half 1955 per cent	First half 1956 per cent	Country	First half 1955 per cent	First half 1956 per cent
Holland	10·8	12·5	Lebanon	0·4	0·5
Sweden	8·4	8·1	Syria	0·5	0·4
Italy	5·8	6·8	S. Arabia	0·7	0·4
Belgium-Luxemburg	6·1	6·5	Afghanistan	0·4	0·4
Switzerland	4·9	5·4	Hongkong	0·2	0·3
Austria	5·0	4·8	Vietnam	0·0	0·2
Norway	3·3	2·9	Japan	0·2	0·2
France	2·5	2·9	China	0·1	0·1
United Kingdom	2·9	2·2	Australia	1·0	0·8
Turkey	2·7	1·6	New Zealand	0·2	0·1
Egypt	2·0	1·2	North America	2·0	3·3
South Africa	1·0	1·1	Argentina	2·2	2·5
French Possessions	0·7	0·8	Venezuela	3·1	2·3
India	2·5	2·3	Colombia	1·3	1·7
Israel	1·3	1·8	Chile	0·5	0·7
Indonesia	0·8	1·4	Brazil	1·8	0·7
Iran	1·1	1·3	Mexico	0·5	0·5
Pakistan	2·3	1·0	Peru	0·5	0·5
Iraq	0·5	0·5	Canada	0·4	0·4
Thailand	0·4	0·5	Cuba	0·2	0·3

Table 3, showing Western Germany's principal suppliers of electrical goods, indicates an encouraging increase in electrical imports from the United Kingdom, mainly due to the still unsatisfied demand in Western Germany for domestic appliances.

TABLE 3.—WESTERN GERMANY'S PRINCIPAL ELECTRICAL SUPPLIERS

Country	First half 1955 (£m)	First half 1956 (£m)	Percentage of total W. German imports 1955	Percentage of total W. German imports 1956
Holland	2·3	2·2	28·0	23·4
United States	1·6	1·9	19·2	19·7
Switzerland	1·5	1·7	18·0	17·4
United Kingdom	1·0	1·4	11·6	13·9
Austria	0·3	0·5	3·3	4·7
Saar	0·3	0·4	3·4	3·6

In parallel with the expansion of her electrical trade, the production capacity of Western Germany's electrical industry was substantially increased as detailed in Tables 4 and 5.

TABLE 4.—BASIC FIGURES OF WESTERN GERMANY'S ELECTRICAL INDUSTRY

	First quarter 1955	First quarter 1956	Increase per cent
Number of employees	462,200	520,400	12
Number of factories	1,757	1,859	6
Total turnover (£m)	194·2	230·0	18
Of which exported (£m)	32·1	38·1	19
Wages (£m)	26·6	33·5	26
Salaries (£m)	14·5	18·3	26

Table 4 not only shows the output increase per employee within one year but also the rise in exports in relation to turnover. Increased manufacturing costs, caused by dearer raw materials and increased wages, were not reflected in Western Germany's competitive power overseas. Further progress in manufacturing methods, combined with reduction of weights, particularly for heavy gear, contributed to her export expansion.

TABLE 5.—WEST GERMAN ELECTRICAL INDUSTRY'S PRODUCTION (£m) (MAIN PRODUCTS ONLY)

Product	First quarter 1955 (£m)	First quarter 1956 (£m)
Motors, generators and parts, excluding welding generators	14·9	18·0
Power transformers and parts	11·7	14·0
Accumulators and batteries	3·2	3·8
H.v. switch and fuse gear	3·1	3·4
L.v. switch and fuse gear	8·3	10·7
Installation material	6·1	6·5
Insulated wire and flex	11·1	13·3
Cables	11·3	11·7
Power tools	1·3	1·8
Welding equipment	1·3	1·7
Industrial furnaces	1·2	1·5
Heating appliances	5·8	8·0
Cookers	1·6	2·2
Motor driven domestic appliances	8·8	13·1
Refrigerators up to 250 litres	5·6	5·9
Telegraph and telephone equipment	7·9	9·1
Wireless telegraph and telephone equipment	1·0	1·3
Radio and TV equipment	13·8	19·3
Electro-acoustical equipment	3·1	4·1
Electronic tubes	2·5	3·2
Telecommunication and h.f. components	4·1	5·7
Electric measuring apparatus	3·2	4·0
Household meters	1·6	1·7
Regulating and controlling equipment	1·5	2·4
Carbons	2·7	3·2
Electrical equipment for vehicles	10·0	11·4
Total electrical production (including W. Berlin)	204·0	251·0(+23%)

The predominance of electronic apparatus and motor-driven domestic appliances, seen in the above table, is not only caused by the necessity to export, but by a still unsaturated potential home market. Both classes therefore should, for a long time to come, represent valuable outlets for the United Kingdom manufacturer.

GENERATION AND DEVELOPMENT

Bankside Power Station Operating Again

After being out of action for about three months because of a fracture in a main cooling water shaft, the Bankside power station of the London Division, C.E.A., was restored to service on Monday last when one of the sets was started up. Bankside is an oil-fired station.

Atomic Power in Ulster

Lord Chandos, chairman of the Northern Ireland Development Council, in his first report on the Council's work to the Prime Minister (Lord Brookeborough) says that, in the view of the Council, the establishment of a nuclear power station in Northern Ireland is of the greatest importance to the future economy of the Province.

New atomic power stations of the Calder Hall type now projected will have a much larger output at smaller cost per kWh generated than the prototype, and scientific authorities now estimate production at a cost which, taking capital and fuel charges together, will in the end compare satisfactorily with that of orthodox coal-fired stations. If this is true in Great Britain, says Lord Chandos, it is evident that atomic power must offer special advantages in Northern Ireland, where not only coal but freight would be saved.

The question of assuring full use of the output of a base-load station even of the minimum practicable size must, of course, be considered alongside that of the probable growth in demand as the economy of the Province expands, "but the call for nuclear power stations elsewhere is growing, and if the programme in Northern Ireland is not to be delayed by difficulties in obtaining specialised equipment, we consider it urgent that a decision on the timetable for establishing the station should be taken and announced."

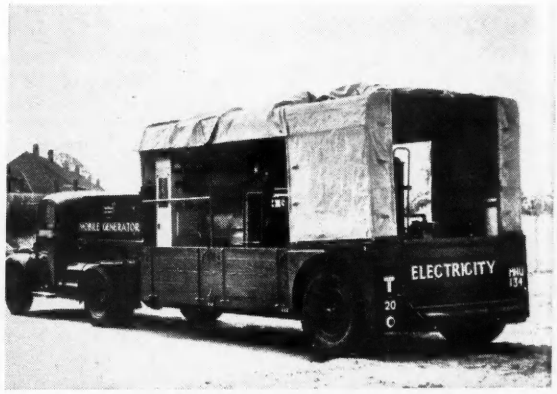
Portable Power Stations

The South Western Electricity Board has given much attention to the all-important necessity of minimising interruptions of supply for maintenance or repair work, and among the measures taken has been the use of "mobile power stations" to provide temporary supplies whenever possible while essential work is carried out on the system.

In a mainly agricultural area, these mobile generating sets are proving invaluable. Six power-stations-on-wheels are at the present time deployed in the South West ready for service where required.

The "mobile power station" is a MacLaren Ricardo 55 kW set mounted on a 6½-ton ex-War-Department articulated trailer. The generator is a 415 V, three-phase, 4-wire, 50 c/s machine and is diesel driven.

The set generates electricity at network conditions and is operated by only one man. It is economical to run and at full load uses only about four gallons of diesel oil an hour. Two oil tanks—one of 70 gallons capacity, the other of 40 gallons—are also mounted on the trailer. The towing vehicle is a 28 h.p. Bedford and is interchangeable with low-load machinery and pole trailers.



One of the South Western Electricity Board's 55 kW mobile power stations

All six mobile sets can be concentrated wherever needed, and their main value lies in their flexibility of supply.

As a rule the mobile generator is used in ensuring continuity of supply in the rural network. Most small villages have only one transformer substation. When it is necessary to carry out routine maintenance on the substation and switchgear, rather than cut out consumers and isolate the community the portable power station is brought into service and connected up to the low-voltage mains.

Distribution Improvements

Durham County Planning Committee has approved proposals by the North Eastern Electricity Board for improvements to the distribution networks in the following areas:—Sedgefield, Houghton-le-Spring, Durham rural area, Consett, Weardale rural area, Easington, Ryton, and Chester-le-Street. In a number of cases the Board is bringing up to date networks formerly owned by the National Coal Board.

Upper Conway Scheme Abandoned ?

In its annual report the Council for the Preservation of Rural Wales says that the Central Electricity Authority appears to have abandoned its Upper Conway hydro-electric scheme. This is deduced from the fact that the C.E.A. had apparently not objected to the Liverpool Corporation's Tryweryn reservoir scheme, which would take a considerable part of the water required for the Upper Conway project. The C.P.R.W. also notes that the Tryweryn reservoir will take a proportion of the top water of the Mawddach hydro-electric scheme, from which it would seem that the C.E.A. is not proceeding with this project either.

The Council expresses pleasure at the appointment of Mr. S. Colin Foulkes, a member of the executive committee, as landscape consultant for the Ffestiniog and Rheidol schemes and says it appreciates what the C.E.A. is doing to further co-operation between the engineers, the landscape consultant and the National Parks Commission.

Transmission Lines in Snowdonia

Referring to the Ffestiniog to Connah's Quay 275 kV transmission line, the C.P.R.W. says that the route to be chosen across part of the Snowdonia National Park, the moors of Denbighshire and the Clwydian hills presents "a most difficult problem." The 136ft towers carrying 13 lines would dwarf or dominate any landscape claiming to have beauty, though it concedes that a plainer landscape, such as high moorland with fairly simple contours, "may be a little more patient of the invader." The report goes on to criticise the inadequate control of overhead line construction. Hydro-electric schemes, it points out, can be discussed and improved before the Private Bills Committee, but in the case of overhead lines no special Parliamentary permission is required.

European Electricity Statistics

The United Nations Economic Commission for Europe has issued a "Bulletin of Electrical Energy Statistics for Europe," which is intended to be an annual publication (41 pages including five tables, in English and French; Geneva, 1s 9d).

The document gives final data supplied by Governments for 1938 and

for 1950 to 1954 and provisional figures for 1955 in regard to 25 countries. It sets out the maximum net capacity of public and private plants in each country in continuous operation at 31st December; fuel consumed; international exchanges of electricity; average efficiencies of public thermal plants; and kWh production and consumption.

An interim bulletin on electricity production, consumption and international exchanges will appear five weeks after the end of each quarter.

Electrically Heated Houses

Plans for 96 houses without fireplaces, space heating being by electrical floor units, were approved on 16th November by the Glasgow Dean of Guild Court. They are the first to be built under the Corporation's Gorbals redevelopment plan and will consist of four blocks of traditional three-storey tenements and a block of 36 maisonnettes, each of two storeys, and contained in a four-storey block.

Rotherhithe Tunnel Lighting

On Wednesday next the chairman of the L.C.C. Rivers and Drainage Committee (Mr. E. E. Woods, J.P.) is to switch on a new fluorescent lighting installation in Rotherhithe Tunnel. Contracts for the work, totalling £35,000, were placed with the City Electrical Co., Ltd., the British Thomson-Houston Co., Ltd., and the London Electricity Board.

Japanese Hydro-Electric Scheme Inaugurated

The Sakuma Dam hydro-electric development in Central Honshu, Japan, was formally inaugurated on 16th October, states a special correspondent of *The Times*. The dam is on the Tenryu River and is said to be the higest in Japan and the seventh largest in the world. It is a concrete gravity structure with a height from bedrock to crest of about 480ft and a width at the summit of over 960ft. The artificial lake formed by the dam stretches upstream for nearly 20 miles.

At one time 15,000 people were employed on the dam and power station and work was carried on for 24 hours a day. The station began to generate power three years after work was first begun and it is now operating at its full normal capacity, supplying power to both Tokyo and Nagoya through the grid system.

The power station, three-quarters of which is underground, contains four turbines which drive generators with a capacity of 93,000 kVA. These were built by the Japanese Hitachi and Toshiba companies. Water reaches the station through two tunnels about three-quarters of a mile long and 23ft in diameter.

The total cost of the project was some £36 million, about two-thirds of which was met through American assistance, either in the form of counterpart funds or of loans from American banks.

Yugoslav Power Exports

On 7th November representatives of the electrical power industries of Austria, the Federal Republic of Germany, Italy and Yugoslavia decided to set up a *syndicat d'études* to carry out the Yugoslav power export scheme known as "Yougelexport." The new organisation will keep the Committee on Co-ordination of the United Nations Economic Commission for Europe informed of its work and will present to the Committee, within a year at the most, its conclusions as well as concrete proposals for the first step in the programme of investment.

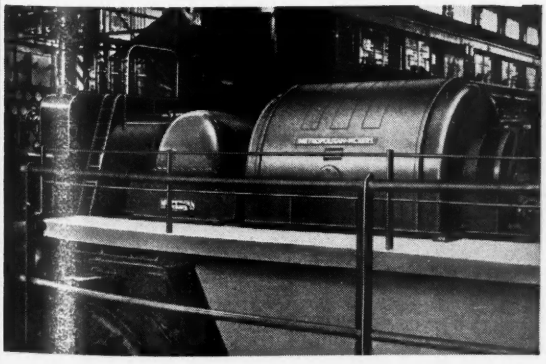
Earlier studies of the "Yougelexport" project demonstrated the possibility of building on Yugoslav territory four central hydro-electric stations whose production would be exported to Italy and the Federal Republic of Germany over a network of power lines of 380 kV. Austria's interest in the project is mainly in a seasonal exchange of energy with Yugoslavia and as a transmitter of energy to the Federal Republic of Germany. Total exportable energy is around 4,300 million kWh per annum. The cost of the entire project has been estimated at about £137 million.

Power for Wood-Pulp Mill

A newsprint and lumbering company, James Maclaren Co., has given notice in the official *Quebec Gazette* that it intends to apply for authority to construct a hydro-electric development on the Lievre River at Dufferin Falls. It is understood that the company contemplates installing two 25,000 h.p. sets. The additional power is required for use in a groundwood pulp mill building close to the paper mill at Masson, Que.

Farmer Seeks Injunction

Last week a Ministry of Fuel and Power inquiry was held into an application by the Central Electricity Authority and the Southern Electricity Board for permission to fell and lop trees on land belonging to Mr. D. J. Glanfield, of Twelve Oaks Farm, Windlesham, Surrey, for the erection of a power line. It was later announced that Mr. Glanfield had given notice that he was seeking an injunction restraining the C.E.A. from entering upon his land and was claiming damages for alleged negligence and trespass.



This 10,000 kW 3,600 r.p.m. Metropolitan-Vickers steam turbo-generator set in Port-of-Spain power station was officially commissioned by the Governor of Trinidad and Tobago on 17th November. (See Electrical Review, *16th November, p. 935*)

STREET LIGHTING

Mr. Duncan Sandys, the Minister of Housing and Local Government, last quarter sanctioned loans to local authorities totalling £648,439 for public lighting.

BIRMINGHAM City Council has been informed that the Ministry of Housing and Local Government has been recommended to grant loan sanction for £100,000 for the next stage of the conversion of the city's gas street lighting to electricity. The full 13-year programme is estimated to cost £1,300,000.

The NEWCASTLE-ON-TYNE City Council is recommended to approve the commencement of work on Stage 2 of its scheme for the conversion of 10,000 gas street lamps to electricity. This stage, involving approximately 1,250 lamps, is estimated to cost £47,000.

WEST LANCASHIRE R.D.C. is recommended to approve a scheme, estimated to cost £9,139, for the provision of street lighting in Ormskirk Road, Aintree.

Experimental fluorescent lighting, the first of its kind in the borough, is to be installed in Poplar Road, SOLIHULL. At present the road is lit by gas.

BRIMINGTON (Derbyshire) Parish Council is to install 57 sodium street lamps at an estimated cost of £3,340.

SUNDERLAND Town Council has received sanction to borrow £7,851 for the provision of improved lighting in Ryhope Road, Sea Road and Pallion Road.

Replacement of gas street lamps by sodium or mercury vapour lamps in London Road, Cambridge Road and The Causeway, GODMANCHESTER, is estimated to cost £10,000.

HOLYWELL U.D.C. has approved proposals by the Merseyside and North Wales Electricity Board for new street lighting in the town at an estimated cost of £13,287.

NEW ELECTRICAL EQUIPMENT

Instrument Cathode Ray Tube

A new range of 3½in instrument cathode ray tubes, type 4GP, to replace the existing 3½in E4412 series, is announced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. Four varieties of screen are available with persistences ranging from 1 millisec to 20 sec. A further screen, suitable for radar applications, will be introduced later although the tube can be made to special order with any of the majority of other standard screens.

The plate sensitivity of the new tube does not vary by more than 2 per cent for deflections up to 75 per cent of the useful scan. Improved spot centring ensures that the undeflected spot will fall within a radius of 5 mm concentric with the tube face. The deflection axes are orthogonal to within 1 deg. Other changes from the E4412 series are single stage post-deflection acceleration, reduced inter-electrode capacitance, a flat-plate glass screen, and a 6·3 V heater. The new tube has a list price of £10.

Paper Capacitors

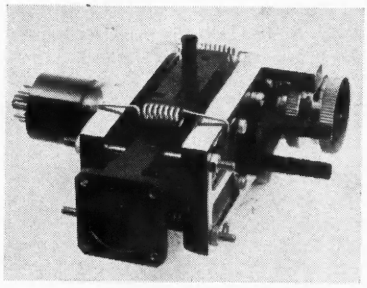
A new type of paper dielectric capacitor which has a performance comparable with that of the more expensive metalcast types is now being made by the PLESSEY CO., LTD., Ilford, Essex. The operative temperature range is −30 to +85 deg C and the component complies with the tropical storage requirements of R.C.S. 11 grade H2. The range of these "Plesseal" capacitors extends from 0·005 μF to 1·0 μF and they can be supplied in either standard or logarithmic ranges. The normal capacitance tolerance is ±20 per cent but tolerances of ±10 or ±5 per cent are available at a slightly higher cost.

"Plesseal" paper capacitors

The voltages covered are 150, 250, 350, 500, 750 and 1,000 V d.c. at 20 deg C; for operation at temperatures over 70 deg C it is necessary to de-rate these figures by 25 per cent. The insulation resistance is greater than 4,000 MΩ/μF at 20 deg C at the rated d.c. working voltage, and this applies even after prolonged periods of storage.

High Power Klystron

The latest klystron, type OKL1B, to be introduced by MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2, is a double-cavity tunable oscillator valve capable of delivering output powers up to 200 W and of operating in the frequency range 8,600 to 10,000 Mc/s. It is therefore useful in c.w. and doppler radar systems, in microwave test gear, and as a driver for larger klystrons. The valve is water cooled and is fitted with an indirectly heated dispenser cathode. Each tube is fitted with two tuning knobs with indicator dials. Frequency can be pre-set with the help of a graph supplied with each tube.



Mullard X-band tunable klystron

Welding Rectifier

A new constant potential 400 A rectifier with a flat volt/ampere characteristic for use with "Argonaut" welding equipment has been produced by the BRITISH OXYGEN CO., LTD., Bridgewater House, Cleveland Row, London, S.W.1.

This rectifier gives optimum self-adjustment of arc conditions and also reduces the possibility of burn back. The flat volt/ampere characteristic means that control of the wire feed can be simplified by dispensing with all voltage sensitive relays, only a current operated relay (built into the power sources) being employed; the function of this is to start the wire feeding as soon as the arc is established. A further simplification is that a magnetic amplifier is no longer required for controlling current and its omission reduces the cost and bulk of the unit.

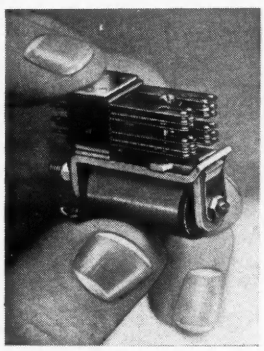
The CPR 400 rectifier is easier to set up and adjust for working conditions and because of the improved self-adjustment no remote current control of the power source is necessary.

Capacitor Bridge

To provide a suitable instrument for those requiring to test tantalum capacitors, the standard electrolytic capacitor bridge, Model CB.154 (Army reference ZD.0296), made by BRITISH PHYSICAL LABORATORIES, Houseboat Works, Radlett, Herts., has been redesigned to incorporate some additional features. Briefly, the capacitance range has been extended to cover values of 0·1 μF to 10,000 μF, while the polarising voltage now extends from 0·5 V to 600 V d.c. in five ranges. These voltages are obtained from an internal source and the a.c. voltage developed across the capacitor under test does not exceed 10 per cent of the d.c. polarising voltage.

Sub-Miniature Relay

A sub-miniature version of the 3000 type relay is now available from D. ROBINSON & CO., 58, Oaks Avenue, Worcester Park, Surrey. Even when fitted with the maximum number of contacts (four change-overs) it only occupies ½in by $\frac{13}{16}$in of chassis space, and projects above by 1¼in. The coil can have any value up to 5,000 ohms and consumes, according to the contact arrangement, from about 0·05 to 0·2 W.

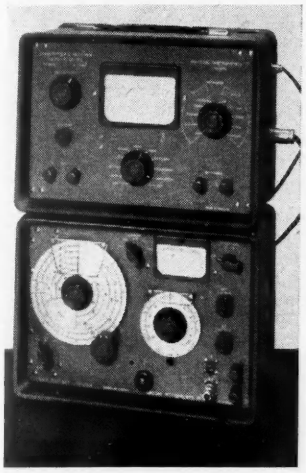


Robinson sub-miniature relay

The blades are buffered and fitted with twin contacts, normally of fine silver, rated at 2½ A at 24 V or ½ A at 100 V (non-inductive). Platinum and other contacts with higher ratings can also be fitted. A feature of this relay is that the fall-off voltage can be set to anywhere between about 10 and 60 per cent of the pull-up voltage. A right-angle fixing bracket, a dust cover and a tool for chassis piercing will be available shortly, as will a sealed version of the relay.

Radio Test Gear

A v.h.f. signal generator and a transmitter and receiver output test set have been introduced by MARCONI INSTRUMENTS, LTD., St. Albans, Herts. These two instruments together provide full facilities for testing f.m. and a.m. mobile transmitter-receiver equip-



Marconi v.h.f. signal generator and transmitter and receiver output test set

ments; their compactness and portability make them particularly suitable for use in the field. The v.h.f. signal generator type TF 1064 consists of an f.m./a.m. signal generator covering 68 to 174 Mc/s and 450 to 470 Mc/s, a crystal i.f. oscillator with five switch-selected output frequencies, and a 1,000 c/s a.f. oscillator. An alternative type, the TF 1064/1, is available for use with narrow-band f.m. systems. The fixed values of deviation are 3·5 and 10 kc/s instead of 5 and 25 kc/s as provided by the TF 1064. In all other respects the two instruments are identical.

The transmitter and receiver output test set type TF 1065 performs four separate functions. It can be switched to act as an a.f. power meter, r.f. power meter, f.m. deviation indicator, or seven-range d.c. voltmeter/ammeter. There is a single multi-scale panel meter. Power is supplied by internal mercury cells. As used in the test set these cells are virtually inexhaustible. The use of a transistor amplifier is an important design feature of the test set, giving it complete independence of external power supplies. Either of the two equipments can be supplied separately.

Audio Output Valve

The GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, has introduced a new audio output valve, the KT88, with an anode dissipation of 35 kW. This valve is a higher-power version of the familiar KT66, although it is smaller in size. It does not replace the KT66, but is complementary to it for output powers in excess of those readily available from existing KT66 circuits.

An example of the usefulness of this new valve for public address equipment is that, at a supply voltage of 500 V, with auto-bias operation, the available power output is 50 W, or twice that obtainable from a pair of type KT66 valves. At a supply voltage of 560 V, with fixed bias operation, an output power of 100 W is available.

The KT88 has a larger cathode, allowing for a higher mutual conductance, and a more modern type of construction, permitting the use of higher anode voltages and dissipations. It is designed for use mainly in a push-pull circuit and will operate satisfactorily as either a triode or a pentode. In the ultra-linear circuit satisfactory operation is obtained with the screen grids connected to tapping points including from 20 per cent to 40 per cent of the total turns of each half-primary.

Concrete Heating Panels

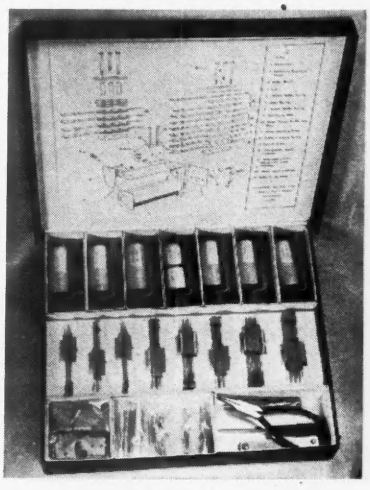
Although the advantages of underfloor heating have been evident for some time the cost usually confines the adoption of this system to new construction. For existing buildings and workshop spaces where overall heating is not installed the new "Thermax" heating panels produced by MARLEY CONCRETE, LTD., Peasmarsh, Guildford, may, however, provide the answer for those who favour this form of heating.

The panels, made from a special grade concrete, have an extremely hard-wearing surface and each measures 2ft square by $2\frac{5}{8}$in deep. They operate on low voltage supplies (9-12 V) through a transformer, and being portable can be repositioned to suit revised production layouts. The loading of each panel is between 70 and 100 W and the heating element, bonded permanently into the panel, is fully backed with insulation material to ensure that maximum surface warmth is obtained.

All corners and arrises are rounded and the panel stands slightly above floor level on shallow legs. The weight is 75 lb and the price, delivered to the nearest railway station, is £10 19s.

Relay Kit

A kit of type 3,000 relay parts has recently been put on the market by STEVENAGE RELAYS, LTD., Gunnels Wood Road, Stevenage, Herts. It enables a wide range of "one off" relays to be made up for use in meeting a variety of problems. Seven coils varying in resistance from 500 to 20,000 ohms are supplied complete with yokes and armatures. A range of contact banks for both light and heavy duty are also included, as are such further items as buffer blocks, screws, etc. To aid in assembly and setting, a screwdriver, box spanner, set of feeler gauges and setting pliers, together with a comprehensive instruction book, are provided.

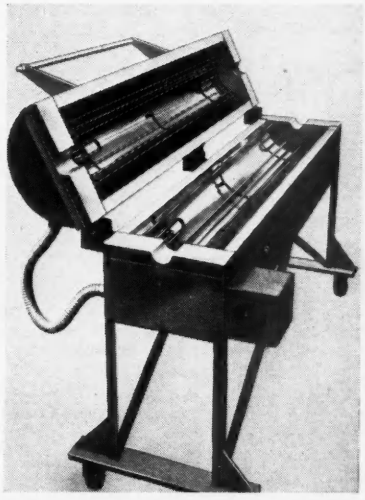


Stevenage Relays 3,000 type kit

Infra-Red Unit

Before photo-lithographic rolls, used by the printing trade, are etched they have to be either varnished or coated with a bitumastic powder to produce an acid resistant surface. This surface has to be heat-cured and in some cases a heater similar in design to a calender heater has been threaded into the rolls which have usually been made of solid copper.

A cheaper and lighter roll which is now used extensively consists of a thin copper tube with steel end pieces. With this new type of roll even heating with a calender type heater is not always possible, due to the change in thickness of material from the ends to the main portion of the roll.



Metrovick heater for curing varnish and lacquer on photo-lithographic rollers

To accommodate the new shell rolls and the older solid rolls a special heater has now been developed by the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17. It is of robust construction and mounted on castors for easy handling. The heater consists essentially of two anodised aluminium reflectors fitted with Metrovick tubular sheathed infra-red heating elements. The loading is approximately 3 kW per ft of heater length, giving a processing time of approximately 10 min. Simple switching is provided to bring additional end elements into use when processing the shell rolls with the solid end pieces.

Financial Section

STOCKS and SHARES

IN the period of four months since the Middle East crisis broke with the seizure of the Suez Canal, Stock Exchange markets have for the most part been gratefully free from the outbreaks of nervous selling which the circumstances might at times have provoked. All the same, a steady process of erosion has been at work on security prices through the routine liquidation of stocks and shares. In consequence, the indices to prices in both the gilt-edged and industrial markets have lately reached the year's lowest points. For gilt-edged, this means also the lowest within most people's experience. In the case of industrials, the index now records an average depreciation of some 11 per cent on the figure ruling at the end of July, when the troubles began, and of some 26 per cent in comparison with the peaks established just a year earlier.

Extent of the Fall

Shares in the electrical equipment and engineering market have resisted as well as any the downward drag on prices but, as the following group of representatives shows, have mostly lost a good deal of ground as a result of the Middle East crisis:—

Share	End-July	26th Nov.	Fall
A.E.I.	68/9	58/9	10/-
Babcock & Wilcox	75/6	68/9	6/9
Brit. Aluminium	76/3	60/9	15/6
B.I.C.C.	50/-	48/-	2/-
Brush	5/9	4/6	1/3
Chloride Elec.	62/6	57/6	5/-
Cole, E. K.	17/6	15/3	2/3
Crompton Parkinson	13/3	13/-	3d
Decca "A"	27/-	24/6	2/6
E.M.I.	27/6	23/-	4/6
English Elec.	53/9	45/-	8/9
Lucas	31/3	28/9	2/6
Parsons	88/9	86/3	2/6
Plessey	68/9	60/6	8/3
Pye "A"	17/6	13/9	3/9
Reyrolle	108/9	92/6	16/3
T.C. & M.	27/6	24/6	3/-
Thorn Elec.	17/6	15/9	1/9
Westinghouse	72/6	67/6	5/-

Company News

Dewhurst & Partners' results for 1955–56 were well up to the expectations which have recently kept the company's 2s shares comparatively firm at around 6s. The dividend for the year is being made up to a total of 16¼ per cent, which is equivalent to an increase of 1¼ per cent on last year's, allowing for the doubling of the ordinary capital by a subsequent scrip issue. With the net profit up by some 15 per cent, the distribution is covered more than 3½ times by profits available.

On the new rate of dividend the yield on the shares goes up to nearly 5½ per cent. The full report from Electric & Musical Industries discloses that total sales of the group in the latest year reached the record figure of £53 million. The 10s shares have been influenced by the uncertain trend of Wall Street; at 23s they stand near the lowest price of the year.

Interim Dividends

More evidence of contracting profit margins in industry came with the

Price Changes in

Company or Board	Nom. Value	Middle price 26th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	72⅛	−1	3	3	4 2 9	80⅛	72⅛
Brit. Elec. 1974/77	100	71⅛	−1	3	3	4 4 0	79⅛	71⅛
Brit. Elec. 1976/79	100	75½		3½	3½	4 12 9	84	75½
Brit. Elec. 1974/79	100	86½		4¼	4¼	4 18 3	95	86½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	19/-
East African Power	£1	19/6	−6d	7	7	7 3 6	21/3	19/6
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/6	−6d	10	10*	13 15 9	17/6	14/6
Equipment and Manufacturing								
Aberdare Cables	5/-	10/-	−1/-	17½	17½	8 15 0	13/6	10/-
Aerialite	1/-	5/-	−3d	45	48	9 12 0	6/9	4/9
Allen, W. H.	£1	36/3		20	10*	5 10 3	39/-	33/6
Aron Elec. Ord.	£1	52/6	−2/6	15	15	5 14 3	56/-	52/6
Assd. Automation	10/-	15/9	+9d	10	5	3 3 6	19/-	15/-
Assoc. Elec. Ord.	£1	58/9	−1/3	14	15	5 2 3	85/6	57/6
Automatic Tel. & El.	£1	50/-		15	15	6 0 0	72/6	50/-
Babcock & Wilcox	£1	68/9	−4/6	15	15	4 7 3	85/6	64/-
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/9
Bakelite	10/-	25/6		16	16	6 5 6	34/-	25/6
Berry's Electric	5/-	6/-		—	10‡	8 6 9	6/6	5/9
British Aluminium	£1	60/9	−3/-	12	12	3 19 0	78/9	40/6
B.I. Callender's	£1	48/-	−1/6	10	12½	5 4 3	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3		6	6	5 13 0	22/6	20/3
British Tabulating	£1	41/3	−1/3	9	9	4 7 3	51/3	37/3
British Thermostat	5/-	25/-		20	25	5 0 0	31/9	24/6
British Vac. Cleaner	5/-	7/9		30	15*	9 13 6	8/9	6/-
Brook Motors	10/-	30/-	−3/9	25	25	8 6 9	44/-	30/-
Brush Group	5/-	4/6		10	10	11 2 3	7/9	4/6
Bulgin, A. F.	1/-	4/6		45	50	—	5/3	4/3
Burco Dean	5/-	8/9		—	22½	12 17 3	13/6	8/3
Chloride El. Storage "A"	£1	57/6	−1/3	17½	17½	6 1 9	73/6	57/-
Clarke Chapman	£1	117/6		20	22½	3 16 6	123/-	89/6
Cole, E. K.	5/-	15/3	−6d	17½	17½	5 14 9	22/3	15/3
Cossor, A. C.	5/-	5/9	−3d	15	Nil	Nil	10/3	5/-
Crabtree	10/-	23/6	−6d	20	20	8 10 3	29/3	23/6
Crompton Parkinson Ord.	5/-	13/-	−3d	16	16	6 3 0	15/-	12/3
De La Rue	5/-	15/3		30	30	9 16 9	20/3	15/-
Decca "A"	4/-	24/6	−1/9	56½	43¾*	7 2 9	44/9	24/6
Desoutter	5/-	29/6	−1/-	25	30	5 1 9	32/9	25/9
Dewhurst	2/-	6/-		30	16¼*	5 8 3	7/6	5/3
Dictograph Tel.	2/-	6/9		20	20	5 18 6	7/3	5/6
Dubilier Condenser	1/-	5/-		25	30	6 0 0	5/3	3/6
Duport	5/-	17/6	−6d	23	25	7 2 9	21/6	13/9
E.M.I.	10/-	23/-	−1/6	15	15	6 10 6	37/-	22/9
Electrical Components	5/-	7/-		25	25	8 18 6*	8/-	6/3
Elec. Construction	£1	22/6	−1/3	8½	8½	7 11 0	29/9	22/6
Elliott Bros.	5/-	22/6	−1/3	17½	20‡	4 9 0	36/9	22/6
Enfield Cable Ord.	£1	13/-	−1/-	Nil	Nil	Nil	19/3	13/-
English Electric	£1	45/-	−1/3	12½	12½	5 11 0	66/3	43/9
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	31/6		20†	20†	3 3 6†	42/9	31/-
Ever Ready	5/-	28/-		35	35	6 5 0	32/9	24/-
Falk Stadelmann	£1	36/3	−1/-	17½	17½	9 13 0	45/9	36/3
G.E.C. Ord.	£1	41/3	−1/3	12½	14	6 15 9	65/6	41/3
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/3		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	19/9	−1/-	25	30	7 12 0	24/6	18/9
Hackbridge & Hewittic	5/-	14/3	−3/3	30	23*	8 1 6	22/-	14/3
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	14/9		10½	11½	7 16 0	19/9	14/-
Holophane	5/-	17/6	−1/-	30	30	8 11 6	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

interim dividend declarations of Hackbridge & Hewittic and Enfield Rolling Mills. In reducing the current payment from 6 to 5 per cent, the former company gave that factor as the reason for a decline in net profits from £237,000 to about £185,000 in the first half of the financial year. Enfield Rolling Mills advise shareholders to expect substantially less favourable results this year, but are holding the interim dividend at 5 per cent on larger capital, propose a share-for-share scrip issue, and anticipate the maintenance of the final dividend at 17½ per cent. Both shares were quoted lower, Hackbridge & Hewittic at 14s 3d and Enfield Rolling Mills at 60s 6d. Metal Industries hope to resume the payment of interim dividends next February, in the absence of untoward events.

Electrical Investments

Company or Board	Nom. Value	Middle price 26th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield% £ s d	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	23/6		70	50	10 12 9	39/3	23/-
I.C.I.	£1	37/6	−1/3	10	10	5 6 9	49/9	37/6
Intl. Combustion	5/-	18/9		25	20*	5 6 9	25/-	15/3
Johnson & Phillips	£1	28/-	−2/-	15	15	10 14 3	46/6	27/6
Lancashire Dynamo	£1	37/6	−2/6	15	11*	5 17 0	49/9	37/6
Laurence, Scott	5/-	14/9		12½	15	5 1 9	16/9	13/3
Lister, R. A.	£1	25/-	−1/9	9·3	10	8 0 0	35/3	25/-
London Elec. Wire	£1	43/-	−1/6	12½	12½	5 16 3	52/9	43/-
Lucas, J.	£1	28/9	−6d	7½	7½	5 4 3	40/3	28/9
Marryat & Scott	2/-	8/9	−9d	30	30	6 17 3	11/3	8/9
Mather & Platt	£1	51/-	−1/-	15	15	5 17 9	65/3	51/-
Metal Industries	£1	22/6	−1/3	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	10/6	−6d	50	50	—	13/9	10/-
Murex	£1	62/-	−3/-	20	20	6 9 0	74/6	60/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/-		14	12	10 0 0	9/6	5/6
Parsons, C. A.	£1	86/3		10	10	2 6 3	96/-	61/6
Plessey	10/-	60/6	−2/6	27½	30	4 19 3	87/6	56/-
Pye "A" Deferred	5/-	13/9	−9d	12½	12½	4 11 0	21/3	14/-
Reyrolle	£1	92/6	−3/9	15	16½	3 10 3	117/6	81/-
Rheostatic	4/-	9/-	−9d	18½	12‡	5 6 9	—	8/3
Richardsons Westgarth	5/-	15/-	−6d	16⅝	16⅝	5 11 0	17/-	13/9
Scottish Cables	4/-	14/9		27½	27½	7 9 3	17/9	14/9
Smith (England), S.	4/-	11/-		17½	17½	6 7 3	14/3	10/6
Southern Areas	£1	13/9		10	7½	10 18 3	28/9	13/9
Strand Elec.	5/-	7/3	−6d	15	15	10 6 9	8/6	6/9
Sturtevant	5/-	22/6		14·4†	15†	3 6 9†	31/3	22/6
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	12/9		20	25	9 16 0	17/-	12/9
Taylor Tunnicliff	5/-	11/3	−1/-	15	15	6 13 3	14/-	11/3
T.C.C.	10/-	36/3		25	25	6 18 6	45/-	36/3
T.C. & M.	£1	24/6	−1/3	8½	8½	6 18 9	34/-	24/6
Telephone Mfg.	5/-	6/-	−3d	10	10*	8 6 9	8/6	6/-
Thorn Elec.	5/-	15/9	−1/-	15	15	4 15 3	22/6	16/-
Thornycroft	£1	34/6	+9d	15	12½	7 5 0	49/9	33/9
Tube Investments	£1	51/3	−2/6	22½	15*‡	5 17 0	70/6	51/3
Vactric	5/-	11/6		15	17½*	7 12 3	15/-	11/-
Veritys	5/-	8/6		12½	12½	7 7 0	10/-	6/9
Walsall Conduits	4/-	11/6	−3d	70	20*	6 19 3	13/6	10/9
Ward & Goldstone	5/-	36/3		30	35	4 16 6	39/6	29/-
Watford	2/-	5/9	+3d	25	25	8 13 9	7/6	5/6
Westinghouse	£1	67/6	−2/6	18	18	5 6 9	100/-	67/6
West, Allen	5/-	11/6	−3d	15	15	6 10 6	14/6	11/6
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/3	−6d	8	8	7 10 6	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	16/-		22½	22½	7 0 9	20/-	15/6
Cable & Wireless: Ord.	5/-	9/6		10	10	5 5 3	11/3	9/6
4% Loan	100	91		4	4	4 8 0	92½	88
Calcutta Trams	£1	25/-	−1/3	6†	7½†	6 0 0†	27/6	23/-
Cape Elec. Trams	£1	16/3		8	8	9 17 0	20/3	16/3
Marconi Marine	£1	31/-		10	10	6 9 0	34/-	31/-
Oriental Tel. Ord.	1/-	67/6	−1/3	16	—	—	90/-	67/6
Telephone Rentals	5/-	9/6	−9d	12½	12½	6 11 6	11/9	9/6

Ever Ready Debenture

The new Ever Ready (Great Britain) 5¾ per cent debenture, of which £1½ million was privately placed last month, is available in the market at an all-in price of a fraction under 100. It is at present £50 per cent paid-up, with a further £47½ due by the end of January, and will be transferable free of stamp duty until a month after that. The stock is redeemable finally at par in 1981, or at a 1 per cent premium from 1976. A sinking fund will be in operation. Interest is to be paid at the end of March and September; the annual amount involved was shown in the prospectus to be covered fifteen times by the average profits of the group over the past three years. In a statement accompanying the issue, the company reported that profits in the current financial year, which runs to next March, should not in the normal course of events be less than that average.

Duport Results

Duport (known formerly as Vono Industrial Products) have duly announced the final dividend of 20 per cent forecast last July at the time of the company's acquisition of Revo Electric's ordinary capital on a share exchange basis. Shares issued in that connection do not rank for the distribution now declared, but will participate in future payments. The group profit of £1·8 million shown in Duport's statement for the year ended in July is not directly comparable with the previous 11-month figure of £834,000 because of differences arising from recent acquisitions, and it includes of course no contribution from Revo. The figures indicate good cover for the dividend. In the market, the price of the 5s shares has been a few pence under the official quotation of 17s 6d. Assuming a total dividend of 25 per cent on the present capital, the yield on the shares is over 7 per cent.

Market Notes

Events have created heavy weather for the quite large number of issues newly launched this month. One of the chief sufferers was the public offer of £10 million British Oxygen 5¾ per cent debenture stock, of which 84 per cent was left with the underwriters. Dealings began this week at a discount of about a point on the issue price of 98. The G.E.C.'s 6 per cent loan stock, which made its appearance a month or so earlier, still commands a premium of a point over par. Offers of new ordinary shares by C. A. Parsons and A. Reyrolle cannot be expected to go out before the necessary meetings called for 18th December, have been held.

REPORTS and DIVIDENDS

Crabtree Electrical Industries, Ltd.—In his circulated review of the group's activities during the year to 31st July last, which has been circulated with the report and accounts, Dr. H. Schofield (chairman) says that the year has been one of considerable progress during which they have more than maintained their lead in the industry and their turnover reached record levels. During the past year they have carried out considerable reorganisation at the Lincoln Works which has enabled them to step up their output considerably. The present relatively low prices of electrical accessories has enabled them to face competition which is keenest in export markets, and to more than hold their own at home. The South African subsidiary of J. A. Crabtree & Co., Ltd., has for administrative convenience been transferred to the holding company, and the results achieved in South Africa continue to improve.

The Radio & Television Trust, Ltd., is reorganising its capital in order to resume dividend payments. The proposals are as follows:—Release from all obligations up to 1st April, 1956, in respect of sinking fund certificates interest and sinking fund; the cancellation of preference dividend arrears up to 31st March, 1956, and release from all obligations of payments to the capital redemption fund and revision of the preference redemption rights. The capital will be reduced by writing 5s off each £1 preference unit and 1s 6d off each 2s ordinary unit. This will enable the debit balance of £509,034 to be written off and leave a surplus of £18,750. This surplus will pay up 750,000 ordinary 6d shares for preference holders as consideration for loss of rights. The remainder of the present unissued capital will be converted into unclassified £1 shares and the capital increased to its present £700,000 by the creation of 217,704 unclassified £1 shares. The directors have no present intention of issuing these shares. Given a continuation of existing trading conditions the directors expect to be able to recommend a dividend on the ordinary shares of 12½ per cent for the year ending 31st March next.

Electric & Musical Industries, Ltd.—In his review circulated with the accounts for the year ended 30th June last, Mr. J. F. Lockwood (chairman) says that total sales of the group were £11·4 million up on the previous year, reaching £53 million. There has been a reduction in the sales of radio and television due to the raising of purchase tax and the tightening of the hire-purchase regulations. Sales of their domestic electrical appliances went up during the year. The main reason for this was the introduction of a new range of electric fires. Their convector heaters are well designed and available in attractive colours. The decision to bring together in one unit the design, manufacture and sale of all capital goods has resulted in the creation of the subsidiary, E.M.I. Electronics, Ltd. The scope of the work on electronic aids to industry and commerce has expanded considerably during the year. Research on television, colour and monochrome, has continued fruitfully, and their new studio camera and equipment employing the latest stabilised Emitron tube is now in use by the B.B.C. They have in production radar and other electronic equipment required for aircraft, and they are also engaged in a new development, the supply of special measuring instruments for nuclear plant.

Exports during the year amounted to £4,429,000, an increase of about £250,000 on the preceding year. There was a general slackening of demand for radio in the second half of the financial year and their exports for the year show a small reduction. Exports of electric irons were further increased and those of recording tape rose continuously and were substantially up on the preceding year. Mr. Lockwood concludes his review with brief references to the company's overseas interests.

Ruston & Hornsby, Ltd.—An issue of £1·25 million 6 per cent unsecured loan stock, 1975-80, at par, is being placed on behalf of the company by Vickers da Costa & Co. The proceeds of the issue will be applied to repaying bank advances, towards meeting the cost of modernisation and as additional working capital.

S. Smith & Sons (England), Ltd.—The group profits for the year to 4th August last amounted to £2,333,495, as compared with £2,635,274 for the preceding year. Taxation absorbs £1,144,852, and the net profit is £1,166,963 (against £1,344,822). The ordinary dividend for the year is unchanged at 17½ per cent with a final payment of 12½ per cent.

The Hackbridge & Hewittic Electric Co., Ltd., has declared an interim dividend of 5 per cent (against 6 per cent).

Enfield Rolling Mills, Ltd., is paying an interim dividend of 5 per cent (unchanged) on increased capital.

The London Electrical & General Trust, Ltd., is paying an interim dividend of 4 per cent (unchanged) on increased capital.

Berry's Electric Magicoal, Ltd., has announced an interim dividend of 4 per cent.

Thomas De La Rue & Co., Ltd., are paying an interim dividend of 10 per cent (unchanged).

Vent-Axia, Ltd., has announced an interim dividend of 30 per cent (unchanged). The directors state that the profit earned by the group before taxation, and subject to audit, for the half year ended 30th September last was approximately £122,094, as compared with £106,152 for the corresponding period last year.

Veritys, Ltd.—Following a letter circulated to stockholders by the stockholders' committee in which the committee urges them not to accept the offer of Limit Engineering Group, Ltd., to acquire the whole of the issued capital of Veritys, Mr. H. B. T. Wilde (chairman) and three directors have issued a letter to stockholders maintaining that the offer is a fair and reasonable one and that in the stockholders' interests it should be accepted.

Belliss & Morcom, Ltd., have declared an interim dividend of 4 per cent (unchanged).

Oldham & Son, Ltd., are paying an interim dividend of 7½ per cent (same).

New Companies

Farrell's (Contractors), Ltd.—Registered 2nd November. Capital £2,000. Electrical engineers and contractors, etc. Regd. office: Old George Chambers, High Street, Market Drayton, Salop.

Computer Developments, Ltd.—Registered 31st October. Capital £10,000. Solicitors: Linklaters & Paines, 59-67, Gresham Street, London, E.C.2.

Liquidations

Radio Maintenance Services (Nottingham), Ltd.—Winding up voluntarily. Liquidator, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3, appointed 2nd November. Particulars of claims to the liquidator by 31st December.

Higgins Radio Services (Middlesbrough), Ltd.—Winding up voluntarily. Liquidator, Mr. A. Scott, 198, Marton Road, Middlesbrough, appointed 8th November. Particulars of claims to the liquidator by 15th December.

Four Fields Radiovision Development Co., Ltd.—Winding up voluntarily. Liquidator, Mr. J. E. Ellis, 50, The Terrace, Torquay, appointed 9th November. Particulars of claims to the liquidator by 8th December.

Bankruptcies

W. Zack, carrying on business at 111, Lordship Road, Stoke Newington, N.16, and formerly carrying on business at 142, Bethune Road, N.16, electrical contractor.—Application for discharge to be heard on 21st December, at Bankruptcy Buildings, Carey Street, London, W.C.2.

W. O. Curry, 17, Kent Close, Bexhill-on-Sea, formerly carrying on business as an electrical contractor at 1, Tynevale Terrace, Lemington-on-Tyne, now electrician.—Last day for receiving proofs for dividend 30th November. Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1.

A. M. Henry, 14b, Woodgrange Avenue, Ealing Common, London, W.5, electrical heating engineer.—First meeting to-day (Friday), at 58-61, York Terrace, Regent's Park, London, N.W.1. Public examination 11th January at the Court House, Half Acre, Brentford, Middx.

A. Le'N. Williamson, Sandringham Hotel, Hope Road, Shanklin, I. of W., hotel proprietor and electrical engineer.—First meeting to-day (Friday), at 16, Westwood Road, Southampton. Public examination 16th January, at the Town Hall, Newport, I. of W.

A. S. Fraser, 553, Romford Road, London, E.7, engineer surveyor, lately trading as Electrical Maintenance Service Co., at 1-3, Shrewsbury Road, E.7, 538, Green Street, E.13, and 33, Central Park Road, E.6.—Trustee, Mr. W. F. Cresswell. Bankruptcy Buildings, Carey Street, London, W.C.2, released 13th November.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 3rd December

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Centre. "The Crystal Palace Television Transmitting Station," by F. C. McLean, A. N. Thomas and R. A. Rowden. (Joint meeting with the Radio & Telecommunication Group, the Supply & Utilisation Group and the Institution of Post Office Electrical Engineers, Birmingham Centre.)

HULL.—Y.E.B., Ferensway, 7 p.m. I.E.S. Leeds Centre. "An Architect's Approach to Lighting Design," by G. Grenfell Baines.

ILFORD.—Angel Hotel, 7.30 p.m. A.S.E.E. North East London Branch. "Reclamation by Metal Spray," by B. H. Devis.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Water Heating," by L. L. Hughes.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey & North Wales Centre. "Some Impressions of a Visit to Russia," by A. R. Cooper. (Joint meeting with the Liverpool Engineering Society.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio and Measurement Sections. Informal evening. Talk on "Electronics and Automation—The Use of Nucleonic Devices," by Dr. D. Taylor. (Joint meeting.)

Caxton Hall, 7 p.m. E.P.E.A. London Technical Group. "Work Study," by P. F. Curry.

MAIDSTONE.—Technical College, 6.30 for 7 p.m. I.E.E. district meeting. "Age and the Incidence of Fires in Electrical Installations," by L. Gosland.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "Ship Stabilisation: Automatic Controls, Computed and in Practice," by J. Bell.

County Hotel, Neville Street, 6 for 6.30 p.m. North East Electrical Club. "The History and Development of the Electric Cooker," by C. D. Braithwaite.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Mineral Insulated Cables for Wiring and Warming," by R. J. Cotton.

Monday, 3rd December, to Friday, 7th December

LONDON.—Earls Court. Smithfield Show and Agricultural Machinery Exhibition.

Tuesday, 4th December

BRISTOL.—The University, 7 p.m. I.E.E. Bristol Graduate & Student Section. "A Study in Automation," by W. E. New.

CAMBRIDGE. — Cambridgeshire Technical College, Collier Road, 6 p.m. I.E.E. Cambridge Radio & Telecommunication Group. Informal evening on "Ultrasonics in Industry;" talk by C. F. Brocklesby.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "Temperature Rises in Electrical Machines on Variable Load and with Variable Speed," by Prof. A. Tustin and Dr. J. J. Bates.

HAMMERSMITH.—Windsor Castle Hotel, 134, King Street, 7.30 p.m. A.S.E.E. West London Branch. "Railway Electrification," by R. W. V. Morton.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. Informal evening on "Electronics and Automation—Some Industrial Applications," by Dr. H. A. Thomas.

LEICESTER. — Grand Hotel, 7.30 p.m. Institution of Works Managers, Leicester Branch. "Radioisotopes in Industry," by K. D. Otteridge.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement & Control Section. "The Absolute Calibration of Voltage Transformers," by W. K. Clothier and L. Medina (to be read by G. W. Bowdler).

21, Bloomsbury Street, W.C.1, 6.15 p.m. Association of Mining Electrical & Mechanical Engineers, London Branch. "Electricity in Mines," by J. Cowan.

Royal Festival Hall, S.E.1, 10 a.m. British Association for Commercial & Industrial Education (BACIE). Conference on "Automation, Education and Training."

At the Royal Society of Arts, John Adam Street, W.C.2, 7 p.m. Incorporated Plant Engineers, London Branch. "Refrigeration and the Heat Pump," by Sir Oliver Lyle.

L.E.B. Service Centre, Regent Street, W.1, 5.30 p.m. Electrical Association for Women, London Branch. Christmas coffee party and "Do it Yourself" exhibition.

MANCHESTER.—Engineers' Club, Albert Square, 7 p.m. I.E.E. North-Western Centre. "The Influence of Modern Scientific Research on Archæology," by Prof. T. Fish. (In co-operation with the University of Manchester.)

READING.—The University, London Road, 7.15 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "The Industrial Uses of Isotopes," by E. W. Jones.

TORQUAY.—Electric Hall, Union Street, 3 p.m. I.E.E. South-Western Sub-Centre. "Digital Computers," by A. C. D. Haley.

TYNESIDE. — A.S.E.E. Tyneside Branch. Visit to the *Evening Chronicle* printing works, at 7.30 p.m.

Wednesday, 5th December

BELFAST.—College of Technology, 7.30 p.m. Belfast Association of Engineers. Annual informal meeting.

CARDIFF.—College of Technology & Commerce, Cathays Park, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Voltage Stabilisation," by Dr. F. A. Benson.

EDINBURGH. — Y.M.C.A., 14, South St. Andrew Street, 6.15 p.m. I.E.S. Edinburgh Centre. "Lighting of Small Factories," by J. S. McCulloch.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. "Power System Protection, with particular reference to the Application of Junction Transistors to Distance Relays," by C. Adamson and L. M. Wedepohl.

HARRINGAY.—"Queen's Head," 677, Green Lanes, N.4, 7.45 p.m. A.S.E.E. North London Branch. "Control of Oil Burners and Building Heating," by S. O. Grant.

LONDON.—I.E.E. London Graduate & Student Section. Visit to Broadcasting House, W.1, at 2.30 p.m. Savoy Place, W.C.2, 6.30 p.m. "Air Navigation," by P. L. M. Rockwell.

At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Institute of Fuel, London Section. "United Kingdom Fuel and Power," by Dr. L. F. Haber.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio & Telecommunication Group. "A Point-Contact Transistor Scaling Circuit with 0·4 Microsec Resolution," by Dr. G. B. B. Chaplin, and "A Junction-Transistor Scaling Circuit with 2 Microsec Resolution," by Dr. G. B. B. Chaplin and A. R. Owens.

Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. Chairman's night and hot pot supper.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, Corporation Road, 6.30 p.m. I.E.E. Tees-Side Sub-Centre. "A Transatlantic Telephone Cable," by Dr. M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey.

NEWCASTLE-UPON-TYNE. — King's College, College Road, 6.15 p.m. I.E.S. Newcastle-upon-Tyne Centre. "Foundations for Inspiration at Home," by T. O. Freeth.

PORTSMOUTH.—College of Technology Extension, Anglesea Road, 6.30 p.m. I.E.E. Southern Centre. "Power Station Auxiliary Plant," by G. F. Kennedy and F. J. Hutchinson.

PRESTON.—R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. "Planning a Lighting Installation," by A. G. Smith.

Wednesday, 5th December, to Friday, 7th December

LONDON. — Olympia. National Poultry Show.

Thursday, 6th December

CARDIFF.—S. Wales Electricity Board's Demonstration Theatre, The Hayes, 7 p.m. I.E.S. Cardiff Centre. "Lighting as a Basis for Design," by D. Phillips.

CROYDON.—Half Moon Hotel, Broad Green, 8 p.m. A.S.E.E. South London Branch. "Motor Maintenance," by P. H. Usher.

At Powers-Samas Accounting Machines, Ltd., Aurelia Road, 7 p.m. Institution of Production Engineers, London Section. "Electronics as an Aid to Production with special reference to the Aircraft Industry," by T. A. Waite.

GLASGOW.—39, Elmbank Crescent, 8 p.m. A.S.E.E. Glasgow Branch. "Lighting of Small Factories," by J. S. McCulloch. (Joint meeting with the I.E.S. Glasgow Branch.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers, ordinary meeting. "The Measurement of Earth-Loop Resistance," by Dr. G. F. Tagg. (Measurement & Control Section paper.)

Bonnington Hotel, Southampton Row, W.C.2, 6.30 p.m. Institute of Electricity Administration. "Recent Developments in Space Heating," by I. C. Hope.

Hope House, 45, Great Peter Street, S.W.1, 7 p.m. Women's Engineering Society, London Branch. Forum on "Technical Education;" chairman, Mrs. F. D. Heywood.

LUTON.—Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Scope and Limitations of Industrial Psychology," by D. B. A. Brasier-Creagh.

MANCHESTER. — College of Technology, Sackville Street, 6.30 p.m. British Institution of Radio Engineers, North Western Section. "Electronic Automation Applied to the Wind Tunnel," by D. S. Wilde.

NOTTINGHAM.—Electricity Service Centre, Smithy Row, 5.30 for 6 p.m. I.E.S. Nottingham Centre. "Lighting at London Airport," by J. G. Holmes.

PETERBOROUGH. — White Lion Hotel, Church Street, 7.30 p.m. Institution of Production Engineers, Peterborough Section. "Nuclear Power and its Effect on the Production Engineer," by I. Munro.

SHEFFIELD.—Grand Hotel. Incorporated Plant Engineers, Sheffield & District Branch. Dinner-dance.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Installation and Operation of a Television Station," by E. P. D. Metcalf.

Friday, 7th December

BIRMINGHAM.—At the County Cricket Club, Edgbaston. Institution of Heating & Ventilating Engineers, Birmingham & District Branch. Annual dinner.

LIVERPOOL.—9, The Temple, 24, Dale Street, 7.30 p.m. A.S.E.E. Liverpool Branch. "Modern Short-Circuiting Testing Technique," by J. G. P. Anderson.

LONDON.—Waldorf Hotel, W.C.2, 7 for 7.30 p.m. Institute of Metal Finishing. Annual dinner and dance.

MANCHESTER.—Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Mechanical Handling Equipment and its Applications," by F. T. Dean.

Saturday, 8th December

LONDON.—Park Lane Hotel, Piccadilly, W.1, 6 for 6.30 p.m. Association of Supervising Electrical Engineers. Ladies' night.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 5th December from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1952

25418. Rauland Corporation.—Cathode heater elements and methods of making such elements. 10th October, 1952. (763049.)

25629. Staatsbedrijf der Posterijen, Telegrafie en Telefonie.—Automatically frequency selective indicating or measuring apparatus. 13th October, 1952. (762753.)

32004. Perl Controls, Ltd.—Electromagnetic valves and the like. 17th December, 1953. (762855.)

1953

2960. Fox, E. G.—Electrically or otherwise mechanically operated dry shaver heads. 15th March, 1955. (762657.)

4148. Babcock & Wilcox, Ltd.—Gas shielded electric arc welding. 13th February, 1953. (763052.)

14953. Electric & Musical Industries, Ltd.—Two state electrical circuits employing transistors. 24th May, 1954. (762859.)

15192. General Electric Co.—Polymerisation of organic compounds with high energy electrons. 1st June, 1953. (762953.)

15575. Philco Corporation.—Composition and manufacture of semi-conductor devices. 5th June, 1953. (763059.)

15935. Standard Telephones & Cables, Ltd.—Electron velocity modulation apparatus. 10th June, 1953. (762758.)

17167. Colman, H. V., and Seddon-Gillespie, R. W. D.—Apparatus for producing an electric current. 22nd September, 1954. (763062.)

17216. Pye, Ltd.—Arrangement for remotely controlling the gain of an electronic amplifier. 16th June, 1954. (762862.)

19776. Foxboro Co. — Automatically balanced network measuring system incorporating transistor amplification. 16th July, 1953. (762954.)

20622. English Electric Co., Ltd.—Servo mechanisms. 23rd July, 1954. (762665.)

20837. Tinsley (Industrial Instruments), Ltd., Steghart, F. L. F., and Kershaw, P. L.—D.c. amplifiers. 20th July, 1954. (762865.)

21249. Amalgamated Wireless (Australasia), Ltd.—Electrical components. 31st July, 1953. (762666.)

22413/560. United Kingdom Atomic Energy Authority.—Circuits using point type transistors. 15th November, 1954. (762867/8.)

22753. Daimler-Benz Akt.-Ges.—Electrical measuring instruments. 18th August, 1953. (762668.)

23450. British Thomson-Houston Co., Ltd.—Apparatus for the detection of infra-red radiation. 13th August, 1954. (762957.)

28083. Francais, Etat.—High-pressure electro-magnetically operated valve having progressive operation. 12th October, 1953. (762876.)

28631. Metropolitan-Vickers Electrical Co., Ltd.—Refractors for street lighting lanterns. 20th October, 1954. (762769.)

29144. Automatic Telephone & Electric Co., Ltd.—Four-terminal networks. 20th October, 1954. (762672.)

29235. General Electric Co., Ltd.—Electric circuit arrangements for operating two or more electric discharge lamps. 22nd October, 1954. (762673.)

29560. General Electric Co.—High frequency diode magnetrons. 26th October, 1953. (763073.)

29813. General Electric Co., Ltd.—Electric frequency discriminators. 28th October, 1954. (762770.)

34159. Metropolitan-Vickers Electrical Co., Ltd.—Circuit arrangements for dielectric heating. 8th November, 1954. (763079.)

35192. Telephone Manufacturing Co., Ltd.—Mounting and electrical connection of electrical components into apparatus units. 26th January, 1955. (762973.)

35861. Siemens Bros. & Co., Ltd.—Multigap cold-cathode electric discharge tubes and their use for counting and like purposes. 25th February, 1955. (762681.)

1954

1865. Shrubsall, G. W. G.—Connectors for electric batteries. 15th April, 1955. (763087.)

2660. General Electric Co., Ltd.—Electric welding apparatus. 28th January, 1955. (762782.)

2727. Plessey Co., Ltd.—Rotary electric switches. 11th February, 1955. (763092.)

2756. English Electric Co., Ltd.—Television receivers. 14th December, 1954. (762685.)

3240. British Insulated Callender's Cables, Ltd.—Means for jointing wire. 2nd February, 1955. (762784.)

3804. British Thomson-Houston Co., Ltd.—Magneto-electric machines. 7th February, 1955. (763094.)

3994. Wolseley Engineering, Ltd., and Drake, R. S.—Electric wire fence. 14th April, 1955. (762686.)

4848. Soc. d'Eléctronique et d'Automatisme. — Analogue-to-digital converters. 18th February, 1954. (763143.)

6119. British Thomson-Houston Co., Ltd.—Electric circuit-breakers of the air- or gas-blast type. 25th February, 1955. (762988.)

7437. Standard Telephones & Cables, Ltd.—Electrical capacitors. 15th March, 1954. (763099.)

7699. General Motors Corporation.—Electrical cutting or grinding of electro-conductive material. 17th March, 1954. (762993.)

8102. Licentia Patent-Verwaltungs-Ges.—Telephone system with two-party connections. 19th March, 1954. (763145.)

8624. British Thomson-Houston Co., Ltd.—Lamp mount making apparatus. 24th March, 1954. (762996.)

8933. Philips Electrical Industries, Ltd.—Tubular fluorescent lamps containing thermionic filament electrodes. 26th March, 1954. (762790.)

9424. International Business Machines Corporation.—Photo-electric scanning of recorded data. 31st March, 1954. (763104.)

9957. Powers-Samas Accounting Machines, Ltd.—Contacts for electric switches and relays. 31st March, 1955. (762999.)

10446. Parsons, Ltd., C. H., and Handley, G. B.—Socket units of electric plug-and-socket connectors. 12th April, 1955. (763001.)

10604. Electric & Musical Industries, Ltd.—Television camera or like head amplifier arrangements. 24th March, 1955. (763002.)

11404. British Insulated Callender's Cables, Ltd.—Mounting of electric cartridge fuse links in contact clips and the mounting of the latter in a fuse carrier. 19th April, 1955. (762698.)

11994. Boart Products South Africa, Ltd.—Dressing abrasive tools by electric means. 26th April, 1954. (763109.)

13411. British Thomson-Houston Co., Ltd.—Photo-electric relay apparatus. 29th April, 1955. (763009.)

14231. General Electric Co.—Mechanical contact rectifiers of the cam operated type. 14th May, 1954. (762799.)

14826. Saunders-Roe, Ltd.—Apparatus for measurement of electric currents. 18th May, 1955. (763012.)

17221. Philips Electrical Industries, Ltd.—Carrier wave telephone transmission systems. 11th June, 1954. (762898.)

17289. Standard Telephones & Cables, Ltd.—Electro-magnetic delay cable and manufacture thereof. 11th June, 1954. (762703.)

17341. Busby, L. R.—Electrically heated vessels for use in making tea and like infusions. 13th June, 1955. (Cognate application 19965, 8th July, 1954.) (763021.)

18370. Crabtree & Co., Ltd., J. A., Wintle, T. D. G., and Middleton, E.—Interlocking mechanisms for enclosed electric switches. 17th June, 1955. (763117.)

18951. Vauxhall Motors, Ltd.—Control devices for electrical power supply units for electrostatic discharge systems. 13th May, 1955. (762808.)

20151. Standard Telephones & Cables, Ltd.—Crystal rectifier and manufacture thereof. 9th July, 1954. (762708.)

20590. Bendix Aviation Corporation.—Electric coupling device. 14th July, 1954. (763026.)

20801. Western Electric Co., Inc.—Impedance matching devices for wave guide junctions. 16th July, 1954. (763149.)

23099. McGraw Electric Co.—High temperature electric transformer construction or the like. 9th August, 1954. (763122.)

23316. Hoover, Ltd.—Suction cleaners. 11th August, 1954. (762910.)

24508. Hecla Electrics Proprietary, Ltd.—Smoothing or pressing irons. 23rd August, 1954. (762712.)

25809. Philips Electrical Industries, Ltd.—Cores for two-dimensional patterns of magnetic trigger units. 6th September, 1954. (763038.)

25900. Piccini, A.—Overhead travelling electric hoist. 7th September, 1954. (763039.)

26027. Philips Electrical Industries, Ltd.—Magnetic circuits for electric machines. 8th September, 1954. (762715.)

26451. Lion, K. S., and Sheetz, J. W.—Electric transducer circuit and system. 13th September, 1954. (762914.)

26457. Automatic Electric Laboratories, Inc.—Carrier communication system. 13th September, 1954. (762915.)

28117. General Electric Co.—Dish-washing apparatus. 29th September, 1954. (762820.)

29499. Philips Electrical Industries, Ltd.—Electric circuits. 13th October, 1954. (762823.)

30903. Radio Corporation of America.—Strip material feeding control device. 26th October, 1954. (762923.)

31328. Sperry Corporation.—Cavity type frequency meters. 29th October, 1954. (762924.)

31814. Triggs, W. W. (Shen, Y. T.).—Electric torches. 6th January, 1955. (762925.)

32280. General Electric Co.—Timing mechanisms for controlling alarms, switches and the like. 8th November, 1954. (763135.)

32400. Philips Electrical Industries, Ltd.—Terminals for resistance elements for variable electrical resistors. 9th November, 1954. (762733.)

32507. Amalgamated Wireless (Australasia), Ltd.—A.c. operable radio receivers. 10th November, 1954. (762926.)

32605. Raytheon Manufacturing Co.—Transducer apparatus. 10th November, 1954. (762829.) 32606. Apparatus for introducing into a body, for therapeutic heating purposes, electro-magnetic wave energy. 10th November. 1954. (762734.)

34569. Telefonaktiebolaget L. M. Ericsson.—Method and apparatus for detecting faults in electric circuit elements. 29th November, 1954. (762833.)

35815. Licentia Patent-Verwaltungs Ges.—Dry rectifier unit. 10th December, 1954. (762936.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Alfreton.—U.D.C. 8th December. Street lighting equipment. Surveyor, Council Offices, Nottingham Road, Alfreton, Derbyshire.

Altrincham. — Borough Council. 15th December. Street lighting equipment. (See this issue.)

Australia.—Victorian Railways. 5th December. 300 kVA transformer. (E.S.B. 29454/56. Ten/22819.)*

Ayr.—Burgh Council. 19th December. Street lighting equipment. (See this issue.)

Blackpool.—Borough Council. 31st December. Street lighting equipment. (See this issue.)

Greece.—Ministry of Finance. 5th December. Electric lamps. (E.S.B. 29495/56. Ten/22805.)*

India.—Director General of Supplies and Disposals. 11th December. Switchboard wire. (E.S.B. 29573/56. Ten/22837.)* 12th December. Jumper and conductor wire. (E.S.B. 29155/56. Ten/22733.)*

Madhya Pradesh Electricity Board. 15th December. 66 kV switchgear and accessories. (E.S.B. 29229/56. Ten/22745.)* 19th December. 3·3 kV and 415 V auxiliary switchgear for Khaperkheda and Paras (Akola) power stations. (E.S.B. 29375/56. Ten/22834.)*

Government of Mysore. 24th December. 13·2 kV outdoor switchgear. (E.S.B. 29565/56. Ten/22814.)*

Saurashtra Electricity Board. 27th December. L.v. and h.v. switchgear. (E.S.B. 29230/56. Ten/22752.)*

Punjab P.W.D. Electricity Branch, Simla. 4th February, 1957. 66 kV and 220 kV switchgear for Bhakra power house. (E.S.B. 29273/56. Ten/22812.)*

Government of Bihar. 13th March, 1957. 30,000 kW steam power station at Barauni. (E.S.B. 29107/56. Ten/22713.)*

Iraq.—Directorate General of Municipalities. 22nd December. Four 50 kVA and eight 100 kVA transformers. (E.S.B. 29301/56. Ten/22750.)*

Keynsham.—U.D.C. 17th December. Street lighting equipment for Park West extension housing estate. Surveyor, Council Offices, Keynsham, Bristol.

Lichfield.—City Council. 10th December. Street lighting equipment. (See this issue.)

Newcastle-on-Tyne.—City Council. 21st January. Electrical installation in the Kenton County Primary School (No. 2). Cairns & Byles, consulting engineers, 8, Osborne Road.

New Zealand.—General Post Office. 16th January. 30 rheostats and 150 insulated jacks. (E.S.B. 29367/56. Ten/22817.)*

Northern Ireland.—Hospitals Authority Management Committee. 19th December. Electrical installation in Forster Green Hospital, Fortbreda, Belfast. J. McCandless, consulting engineer, 6, Murray Street, Belfast.

Pakistan.—West Pakistan Directorate of Industries. 10th December. 20 radio sets. (E.S.B. 29212/56. Ten/22719.)*

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 10th December. Electrical equipment including copper wire, insulators, armoured cable, cut-outs, reflectors, etc. (E.S.B. 29384/56. Ten/22795.)*

Romford.—Borough Council. 5th January. Electric lamps for one year. Borough engineer, Town Hall.

Rothwell (Northants). — U.D.C. 18th December. Street lighting equipment. (See this issue.)

South Africa.—Stores Department, South African Railways. 7th December. Overhead track equipment. (E.S.B. 29357/56. Ten/22788.)* 12th December. Four electrically operated holding furnaces for a brass foundry. (E.S.B. 29188/56. Ten/22736.)* 19th December. Electrically heated salt bath furnace. (E.S.B. 29189/56. Ten/22737.)* 21st December. 120 kW generating set. (E.S.B. 29359/56. Ten/22789.)* Copper catenary wire. (E.S.B. 29358/56. Ten/22808.)* 11th January. Cadmium copper strip. (E.S.B. 29360/56. Ten/22809.)*

Spain.—Iberduero, S.A., Madrid. 9th December. Four pneumatically operated circuit-breakers and one transformer group of three units of 100 MVA. (E.S.B. 29203/56. I.C.A. Ten/22738.)*

Stockton-on-Tees.—Borough Council. 21st December. Street lighting equipment. (See this issue.)

Thailand.—Thai Technical and Economic Committee. 18th December. Equipment including five 35 kW diesel-driven generators, and thirteen radio-telephone transmitter/receivers. (E.S.B. 29324/56.I.C.A. Ten/22797.)*

Uganda.—Electricity Board. 31st January. Overhead line equipment. (See this issue.)

United States.—Bureau of Reclamation. 6th December. Eighteen 50 kVA, nine 75 kVA, six 100 kVA and nine 150 kVA distribution transformers and lightning arrestors. (E.S.B. 29027/56. Ten/22758.)*

City of Seattle. 6th December. Insulated wire. (E.S.B. 29542/56. Ten/22867.)*

Uruguay.—Administracion de Ferrocarriles del Estado. 27th December. Galvanised steel braided cable. (E.S.B. 29295/56. Ten/22760.)*

Administracion General de las Usinas Electricas y los Telefonos del Estado. 22nd February, 1957. 28,000 dry cells. (E.S.B. 29297/56. Ten/22785.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

London.—St. Pancras Borough Council. Electrical work at the Goldington Crescent housing scheme (£3,389).—Electrical Power Installation Co.

Weymouth.—Corporation. Recommended. Installation of Class "A" street lighting at Preston Road, Abbotsbury Road and Chickerell Road (£14,286).—A.E.I. Lamp & Lighting Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Barnes.—Flats (32), Mortlake High Street; borough surveyor.

Bathgate.—Houses (147), Boghall and Kirkton (including electrical work), for T.C.; John Grant, architect, Melville Street, Edinburgh.

Beverley.—Office block, shipyard; Cook, Welton & Gemmell, Ltd., shipbuilders, Grovehill.

Blyth.—Pithead baths at Crofton Mill Pit; N.C.B. Architects' Department, Whitley Road, Longbenton.

Bracknell.—Factory; Spanner Boilers, Ltd., 10, Hopton Road, London, S.W.16.

Bristol.—Houses (41), Wick Crescent, Brislington; J. Nelson Meredith, city architect, Council House, College Green, 1.

Burnley.—Hostel for aged persons, Harold Avenue; Hitchon, Pickup & Halstead, architects, 8, Calder Street.

Cardiff.—Four five-storey blocks of offices, Greyfriars Road district; E. R. Bugden and Partners, chartered surveyors, St. Mary Street.

Carlisle.—Warehouse, Durranhill trading estate; Firestone Tyre & Rubber Co., Ltd., Great West Road, Brentford.

Charlton Kings.—Secondary modern school, East End Farm site; county architect, Shire Hall, Gloucester.

Darlington.—Houses (372), Skerne Park, second stage; E. R. Tornbohm, borough architect, Central Buildings.

Houses (32) at Great Aycliffe; R. Brown, 123, Victoria Road, Darlington.

Dewsbury.—Houses (375), Valley Road housing site; borough surveyor, Municipal Buildings, Halifax Road.

Doncaster.—Houses (176) at Intake; borough architect.

Dover.—Flats (221), Marine Parade; Dalgliesh & Pullen, architects, 17, Fitzhardinge Street, London, W.1.

Durham.—New county offices at Aykley Heads (£1,500,000) and additions to Dinsdale Park Residential School (£23,000); county architect, South Street.

Essex.—County junior school, Corringham (£50,000), and county primary school, Basildon (£90,000); H. Conolly, county architect, County Hall, Chelmsford.

Fareham.—Houses (45), Park estate; F. D. McLaren, builder, Elmhurst, The Quay.

Felling-on-Tyne.—Depot block offices, stores and block of garages; R. Morton, U.D.C. Offices.

Flint.—Shops (14), with office, storage and living accommodation, Chester Street; borough engineer, Municipal Offices, Earl Street.

Gosforth.—Houses (2,000), North Gosforth; Cussins (Builders), Ltd., Gosforth, Newcastle-on-Tyne.

Grantham.—Houses (109) for T.C.; Rudd & Son, Ltd., Wharf Road.

Guisborough.—Old people's bungalows (30); U.D.C. surveyor.

Hastings.—Dwellings (59), off Pilot Road; Lionel H. Fewster & Partners, architects, 5, Liverpool Gardens.

Havant.—Over 1,000 houses at Cowplain, with community centre, swimming pool, etc.; Figgins & Son, Ltd., Little Park Estate, Bedhampton, Havant.

Hemel Hempstead.—Factory for Base Metal Products, Ltd.; J. Jarvis & Sons, Ltd., builders, 239, Vauxhall Bridge Road, London, S.W.1.

Hull.—Office block and canteen, Wincolmlee; British Road Services, 31, York Place, Leeds.

Jarrow.—Seven-storey flats, Queens Road; H. W. T. Perkins, borough engineer.

Kenley.—Houses (134), Hayes Lane; West Wickham (Kent) Land Development Co., Ltd., 22, George Street, Croydon.

Kew.—Flats (32), West Hall Road; borough engineer for Barnes, Municipal Offices, Sheen Lane, Barnes.

Leicester.—Factory on site bounded by Burgess Street, Vine Street and Elbow Lane; Ellis Bros. (Leicester), Ltd., engineers, Causeway Lane.

Secondary modern boys' school in Melton Road; city architect.

London.—Factory, Western Avenue, Acton; Aircraft Steel Structures, Ltd., 7-17, Ansdell Street, W.8.

Dwellings (36), Anerley Vale, Penge; borough surveyor.

Rebuilding works and offices, Southwark; Rae Stage Equipment, Ltd., 8-10, Lant Street, S.E.1.

Manchester.—Hotel and office block, Parker Street; Graham Family Settled Estates, Ltd., and Sir Keith Joseph, 6, Pall Mall East, S.W.1.

Middlesbrough.—Accident wing at Middlesbrough General Hospital for Newcastle Hospital Board (£418,000); F. Shepherd and Sons, contractors, York.

Newcastle-on-Tyne.—Flats and maisonnettes (120), and five-storey blocks at Walker Road; Cussins (Contractors), Ltd., The Drive, Gosforth.

Additional mental hospital accommodation in the Darlington area (£1,500,000); P. H. Knighton, chief architect, Newcastle Regional Hospital Board, Benfield Road.

Northern Ireland.—Renovation works at Ulster Hall, Belfast (£56,000); city surveyor, City Hall.

New building at North Street/Waring Street corner site for Belfast Banking Co., Ltd., Waring Street, Belfast.

Oxford.—Church, Kennington; Hutchins & Green, Ltd., builders, 1a, Southmoor Road.

Peterborough.—Houses (81), Oxney Road; Peterborough Estates, Ltd., 31, Priestgate.

Secondary modern school; Joint Education Board's architect, Bridge Street.

Portsmouth.—Works extensions; De Havilland Aircraft Co., Ltd., The Airport.

Romford.—Houses (256) and shops (12) with flats, Harrow Crescent; J. Twinn, town clerk, Town Hall.

Sedgley.—New headquarters with workshops, social centre, etc., in Dudley Road (£150,000); Wolverhampton, Dudley and Districts Blind Institution, 62, Waterloo Road, Wolverhampton.

South Shields.—Workshop, showrooms and petrol station, Commercial Road; G. C. Monk & Co., Ltd., South Shields.

Southall.—Factory on site near Yeading Brook, Uxbridge Road; Abbott Bros., High Street.

Spennymoor.—Shops on the Middlestone Moor estate, houses (30) and bungalows (6), at Byers Green, for the U.D.C.; Gray & Partner, architects, Camden Street, North Shields.

Sunderland.—Bus depot, Dundas Street; T. Donkin, borough engineer, 27, Fawcett Street.

Surbiton.—Houses (52), Fullers Way; C. C. Burton, builder, 319, Hook Rise.

Swansea.—Houses (490), Sketty Park estate; borough architect.

Thornaby-on-Tees.—Factory and offices, Stephenson Street; Laddercraft, Ltd., Stockton Street, West Hartlepool.

Wallsend.—Warehouse, Station Road, for Swan Hunter and Wigham Richardson, Ltd., Wallsend.

Watford.—Francis Combe Secondary Modern School (£85,658); C. H. Aslin, county architect, County Hall, Hertford.

West Bromwich.—Four-storey offices, Lombard Street West; H. Holland, architect, Ryland Chambers, Edward Street.

West Hartlepool.—Houses (58) at Owton Manor and Farndale Road; A. G. Sinclair, borough architect.

Offices and shops, Lucan Street and York Road, for the Pearl Assurance Co., Ltd.; Kitching & Co., architects, Albert Road, Middlesbrough.

Weymouth.—Houses (110), Littlemoor area; S. W. Foster, Ltd., builders, Coombend, Radstock.

Whitehaven.—Three-storey flats in George Street and Peter Street for the T.C.; John Laing and Sons, builders, Dalston Road, Carlisle.

Worthing.—Dwellings, Limbrick Lane (64), and at Harefield Avenue (48); E. G. Townsend, town clerk, Town Hall.

CANADIAN ELECTRICAL EXPORTS

LAST year Canadian electrical exports again declined though less than in 1954. Their total value was $20·7 million compared with $23 million. The accompanying table shows the values of the chief groups, with notes of increases or decreases on the previous year and some of the leading destinations. Conspicuous among the lines which showed a falling off were radio goods, dynamos and generators, batteries and heating devices. On the other hand there were increases in transformers, telegraph and telephone apparatus and motors. From the widespread distribution of the trade it is evident that Canadian exporters leave no possible market unexplored.

Class of Goods	1955 $(000)	Inc. or dec. on 1954 $(000)
Vacuum cleaners	6	− 1
To Mexico	2	—
,, *U.S.A.*	3	− 1
Washing machines, domestic	558	+ 28
To Union of S. Africa	35	+ 10
,, *Trinidad*	11	+ 7
,, *Arabia*	12	+ 7
,, *Hungary*	11	+ 11
,, *Iraq*	10	− 3
,, *Netherlands*	15	+ 10
,, *Netherlands Antilles*	25	+ 25
,, *Peru*	58	− 12
,, *Switzerland*	56	− 14
,, *Puerto Rico*	18	+ 18
,, *Venezuela*	95	+ 31
,, *Lebanon*	44	+ 30
,, *Syria*	27	+ 15
Cooking stoves	120	+ 29
To Union of S. Africa	13	+ 10
,, *Bermuda*	16	− 1
,, *Jamaica*	5	+ 2
,, *Trinidad*	9	+ 1
,, *Ireland*	9	+ 9
Heating and cooking devices	97	− 156
To Union of S. Africa	13	+ 13
,, *British Guiana*	4	+ 2
,, *Jamaica*	5	+ 2
,, *Peru*	6	—
Storage batteries	92	− 138
To Ceylon	4	− 4
,, *Malaya*	5	+ 5
,, *Chile*	10	+ 10
,, *Colombia*	23	− 103
,, *Egypt*	9	− 7
,, *Thailand*	5	+ 2
,, *Venezuela*	6	− 9
Storage battery parts	144	+ 60
To Union of S. Africa	14	+ 10
,, *Venezuela*	27	+ 8
,, *U.S.A.*	96	+ 71
Batteries, n.o.p., and parts	61	− 129
To Denmark	4	− 71
,, *France*	4	− 13
,, *W. Germany*	5	+ 5
,, *Greece*	15	+ 15
,, *Mexico*	15	+ 15
Receiving sets	955	− 561
To Hongkong	33	+ 32
,, *Chile*	16	− 8
,, *Colombia*	67	+ 45
,, *Cuba*	23	− 4
Receiving sets (*continued*)		
To Korea	10	− 2
,, *Indonesia*	10	+ 9
,, *Panama*	42	+ 36
,, *Peru*	12	− 8
,, *Thailand*	431	+ 344
,, *Venezuela*	141	+ 71
,, *U.S.A.*	98	− 125
Radio apparatus, n.o.p.	4,803	− 2,033
To U.K.	92	+ 45
,, *India*	966	+ 827
,, *Pakistan*	251	+ 203
,, *Australia*	71	− 23
,, *Colombia*	159	+ 131
,, *W. Germany*	289	+ 289
,, *Mexico*	104	+ 60
,, *Thailand*	29	+ 26
,, *Venezuela*	39	+ 33
,, *Portuguese W. Africa*	32	+ 10
,, *U.S.A.*	2,629	− 2,659
Telegraph and telephone apparatus	2,066	+ 279
To India	83	+ 83
,, *Bolivia*	15	*
,, *Brazil*	101	+ 36
,, *Mexico*	28	+ 23
,, *Portugal*	71	+ 70
,, *Portuguese W. Africa*	12	+ 12
,, *U.S.A.*	1,715	+ 103
Transformers and parts	1,625	+ 431
To India	213	*
,, *Ceylon*	66	*
,, *New Zealand*	59	+ 59
,, *Belgium*	25	+ 9
,, *Brazil*	961	+ 290
,, *Chile*	155	+ 155
,, *Colombia*	26	+ 21
,, *El Salvador*	39	− 4
,, *U.S.A.*	55	− 82
Dynamos, generators and parts	1,450	− 919
To India	210	+ 191
,, *Brazil*	583	− 1,589
,, *Colombia*	336	+ 336
,, *U.S.A.*	283	+ 168
Meters and parts	1,394	+ 24
To Union of S. Africa	23	+ 4
,, *Ceylon*	13	+ 13
,, *Australia*	33	+ 13
,, *Bolivia*	26	− 8
,, *Brazil*	386	− 241
,, *Colombia*	96	+ 44
Meters and parts (*continued*)		
To Costa Rica	62	+ 42
,, *Cuba*	88	+ 42
,, *Dominican Republic*	66	+ 23
,, *El Salvador*	50	+ 38
,, *Guatemala*	17	− 10
,, *Mexico*	294	+ 27
,, *Venezuela*	163	+ 67
Motors and parts	1,304	+ 179
To Union of S. Africa	49	+ 45
,, *New Zealand*	42	− 46
,, *Costa Rica*	47	+ 42
,, *Mexico*	363	+ 230
,, *Panama*	18	+ 5
,, *Peru*	15	− 3
,, *Puerto Rico*	27	+ 16
,, *Venezuela*	45	− 15
,, *Yugoslavia*	14	+ 13
,, *U.S.A.*	603	− 22
Spark plugs	2,114	+ 82
To Union of S. Africa	622	+ 156
,, *India*	336	—
,, *Belgium*	161	− 6
,, *Indonesia*	100	+ 66
,, *Sweden*	164	+ 118
,, *Switzerland*	79	+ 11
,, *Venezuela*	77	− 133
Switches and wiring devices	197	+ 54
To India	8	− 15
,, *British Guiana*	7	—
,, *Trinidad*	26	+ 18
,, *Brazil*	82	+ 72
,, *El Salvador*	10	+ 5
,, *Netherlands*	26	+ 26
,, *U.S.A.*	11	− 10
Lamps, floor, table, etc.	37	+ 11
To Jamaica	9	+ 7
,, *U.S.A.*	14	+ 5
Lighting fixtures and parts	110	+ 61
To Jamaica	14	+ 12
,, *U.S.A.*	83	+ 53
Electrical apparatus, n.o.p.	4,227	+ 483
To Union of S. Africa	202	− 36
,, *India*	222	+ 187
,, *Brazil*	718	− 570
,, *Italy*	259	− 36
,, *U.S.A.*	1,827	+ 820
Total	20,700	− 2,300

* Amount negligible in 1954.

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